

With a sliding seat, therefore, we seem to have a provision for greater range of movement at the distal end of the lever. In the upper extremity it seems to me we find the same principle at work, and if so it is curious that we should have adopted as a novelty or an invention what nature has provided us with in other points, that we should apply to the lower extremities in rowing the same principle that already exists in connection with the upper, and is brought into action perhaps especially in rowing, and that this should have been done unknowingly.

The bony framework of the upper limb is connected with that of the trunk at only one point, the inner or sternal end of the collar-bone, and it is round this point that movement occurs. The greatest freedom of motion, however, takes place at the shoulder-joint, and as this joint is, moreover, at the apparent junction of the free limb with the body, the movements here are generally looked into to the exclusion of those at the junction of the collar-bone and breast-bone. But the importance of the latter will at once be recognised when it is considered that the collar-bone and shoulders rotate round the upper part of the breast-bone, and according to their length and mobility will move through a larger or smaller arc.

The amount of movement between the extremes of forward and backward positions of the shoulder (Figs. 1 and 2) can be readily tested, and I have found that the average of several observations on different individuals, taken at the tip of the shoulder, the chest being absolutely fixed, is from six to seven inches; or, in other words, the tip of the shoulder moves backwards and forwards to that extent between the extremes of forward and backward movement.

Similarly in the vertical line a large extent of motion occurs, the difference between the extremes being on the average four inches. Now, when it is noticed that the arm moves at the shoulder-joint with an extraordinary amount of facility, and that its chief motions as a mechanical appendage to the trunk occur in that articulation, we are led to look upon the arm, fore-arm, and hand as a compound lever, working with its one end free and the other rotating in the socket of the shoulder-joint.

In the lower extremity we also find the compound lever working with one end somewhat similarly in a socket. In the case of the upper, however, the socket is a movable one, slipping backwards and forwards freely with the limb and strangely increasing its range of motion; still capable of being fixed firmly in position by the superficial muscles of the back. But in the lower extremity the socket is fixed, and there is no provision for sliding, since strength rather than range of motion is wanted, and where greater range of motion is needed, as in rowing, there a blind application of the principle found in the upper extremity has been only recently effected.

I have referred only to the sliding fulcrum at the shoulder as seen on both sides equally, and as is best exemplified in the position of the arms in rowing, when however the whole trunk also moves; but it must be borne in mind that a still further sliding of the fulcrum is constantly taking place when one hand alone is used, for the chest is also turned towards the object to be reached, by rotating and flexing the spine. The advantage of the vertical motion is seen in such actions as bell-ringing, weight-lifting, &c. Moreover it must be noticed that when the lever forming the arm is raised from the side to a right angle with the body it has reached its limit of motion at the shoulder-joint, and that subsequently the upward motion occurs in the collar-bone, since the top of the shoulder checks the further movement of the arm upwards. There is in connection with the lower extremity a somewhat similar mechanical arrangement, which is not however brought into play so fully as in the upper. The sockets of the hip-joints can be brought forward by a rotation of the spine. This is especially noticeable in those who are prevented from using their feet freely, where therefore the elasticity and spring which are so wonder-

fully provided in the foot are lost, and the length of stride is obtained by the utmost use of mechanical advantages commonly unused in connection with the hip. Ploughmen and labourers whose feet are cased in unyielding clogs walk from the hips, or in other words they slide the fulcrum forwards by rotating the spine, whereby they gain a larger stride.

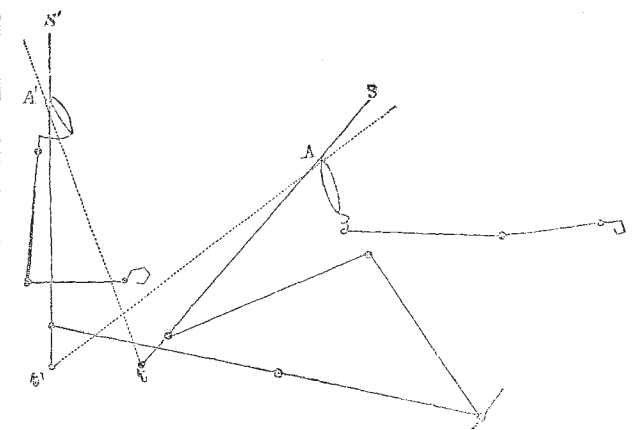


FIG. 3.—Diagram to show sliding-seat action at the shoulders. In the forward position the arm is thrown forward so that the shoulder is about three to four inches in front of the spinal line  $SA$ . In the backward position the same point is about one to two inches behind the same line  $S'A'$ , the whole movement occurring at the sterno clavicular articulation. The sliding of the tuberosities of the ischia backwards in this movement is equal to about eight inches ( $t$  to  $t'$ ). The dotted lines show the degree of forward or backward movement of the body which would be necessary to gain the same range of arm-movement, if the tuberosities were fixed and no sliding were used.

Such then are some of the curiosities of animal mechanics seen in our wonderful framework, and the subject would repay us in interest as well as in usefulness if studied more by those who are concerned in mechanics generally.

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## THE BRITISH ASSOCIATION

BRISTOL, Tuesday Night

OUR meeting has nearly run its course, and may so far be pronounced a great success. Brilliant weather has been added to hospitality and to skilful direction, and has produced a generally harmonious result. We may certainly expect that the Association, not less than the Bristol people, will desire a repetition of the visit within somewhat fewer than forty years.

Partly owing to the comparative weakness of the President's voice, and partly to the deficient acoustic properties of Colston's Hall, the President's address was not quite so successful as it might otherwise have been. Even Prof. Tyndall had to strain his voice considerably in order to be well heard. Perhaps the most forcible ideas left on the mind by Sir John Hawkshaw are his patience and caution, his dislike for taking leaps in the dark, and his eager desire to take steps in advance when the way can be seen with tolerable clearness. His modesty in not referring to any of his own great achievements, when pertinent references might have been made, was very noticeable. Prof. Tyndall, in his admirable opening address, spoke as follows:—

"It is my privilege to introduce to you as your president for the coming year Sir John Hawkshaw, a name celebrated throughout the world for the practical application to works of the greatest magnitude of some of these sciences which it is the function of this Association to foster and advance. In him, I doubt not, you will have a wise and prudent head, a leader not likely to be caught

up into atmospheric vortices of speculation, about things organic or inorganic, about mind or matters beyond the reach of mind, but one who, struggling, Antæus-like, with his subject here to-night, will know how to maintain throughout a refreshing contact with his mother earth. I have looked forward for some time to the crowning act still in prospect of his professional career, to give our perturbed spirits rest in crossing the Channel in visiting our fair sister France. But pending that great achievement, it is his enviable lot to steer this British Association through calm waters to a haven of, at all events, temporary rest—rest all the more sweet and needful from the tempestuous weather which rasher navigators who preceded him thought it their duty to encounter rather than to avoid. To his strong hand I commit the helm of our noble barque, wishing him not only success, but triumph in that task he has undertaken, and which I now call upon him to fulfil."

Both papers and discussions have been of very high interest. Some of the papers mark epochs in science: such as Prof. Cayley's, on the theory of chemical combinations. The Transit of Venus, the proposed flooding of the Sahara, the Deep-sea Fauna, oceanic circulation, Murchison's classification of Palæozoic strata, the ethnography of races at the commencement of civilisation, the Channel and Severn tunnels, the coal question, and railway safety, may be mentioned among the chief subjects of wide interest. Social subjects have had a full share of attention, considering the pre-scientific stage in which most of them are.

Some of the personally interesting scenes have been rather notable—as when Sir W. Thomson, in relation to Mr. Croll's assault on Dr. Carpenter's doctrines of oceanic circulation, pronounced that Dr. Carpenter's demonstration was most conclusive and his reasons irrefragable; when Prof. Hull, criticising Prof. Hughes, said he had never before heard so many heresies in so few minutes; if it were possible for his hair to stand on end it would immediately begin to friz out from the centre to the circumference; and when Mr. John Evans, Canon Tristram, and Canon Rawlinson combined to give a wholesome exposition of sound doctrine in ethnological subjects and of the relative value of various kinds of evidence, after the reading of a paper which was destitute of scientific principles.

Dr. Carpenter was as happy as ever in his lecture to working men, on "A Piece of Limestone." He had a great audience of unmistakeable working men, with whom he placed himself in most cordial rapport.

Mr. Samuel Morley, M.P., after the lecture, said the subjects of the Association meeting were those in which working men were deeply interested, for the competition of manual labour must give way to the competition of intellect. Men who wanted to get on, and masters who wished to hold their own, must unite in promoting, by their own investigation, the knowledge and the philosophy which were to be found in, or connected with, their various manufactures. Mr. Bramwell's lecture was of a useful kind, but defended engineers and railway directors perhaps too much.

Mr. Spottiswoode's lecture on the Colours of Polarised Light was very successful both in exposition and in experimental illustration. The lecturer used a splendid instrument, in which two Nicol's prisms of great size, and beautifully cut, serve the purpose of polariser and analyser, with which he was able to secure the maximum of illumination with a large field of view. The meeting was made more interesting by Sir John Hawkshaw's announcement that the President of the French Association sitting at Nantes had that day telegraphed an expression of their good will and of their wishes for the success of the Bristol meeting. His call for a manifestation of their hearty reciprocation of those feelings was responded to with enthusiasm.

Since no other sectional address was delivered on Friday morning, Prof. Rolleston had a crowded audience to hear his address to the Anthropological Department of Section D. His auditors had one of the greatest treats the meeting has afforded, and the vigorous individuality, the vivacity of thought and action, the boldness and fearlessness, and the wit, scholarship, and research of the Professor must have been vividly impressed on many. At the commencement of the address, when he had to give directions for the opening of an extra door in order to allow a crowd of persons in the corridor outside to hear him, his sudden sally describing their desire to enter "for reasons inscrutable to me" was highly characteristic and appreciated; and the passages in which he spoke of the relative capacity of female crania compared to men's in former and present days, the toleration of nuisances and epidemics, the deterioration and improvement of races, and the value of missionary labours, were listened to with deep attention.

The microscopical *soirée* on Thursday evening was a very great success, and the Association owes its hearty thanks to Messrs. W. Tedder and J. W. Morris, the secretaries respectively of the Bristol and Bath Microscopical Societies, and to the members of those societies. A bold idea was well carried out, viz., that of exhibiting chiefly living objects. The 110 microscopes were arranged in classified divisions, devoted to Crustacea, Arachnids, Insecta, marine and fresh-water fauna, ciliary action, vertebrate circulation, vegetable circulation, fertilisation of flowers, Cryptogamia, microspectroscopes, &c. The idea of practically illustrating Sir John Lubbock's "Fertilisation of Flowers by Insects" was novel, and so far carried out as to give a vivid idea of the processes to those who were previously unfamiliar with them. The geological division included an exhibition of the perennial *Eozoon canadense*, which must be exhibited again and again to live down the hostility to its animal nature. Altogether the exhibition was a great evidence of scientific enthusiasm, which had led many ardent students to make special dredging and fishing expeditions both in inland and marine waters.

The Museum of the Bristol Museum and Library Society has been a very considerable attraction. Bristol is exceptionally fortunate in its museum, to which the local Naturalists' Society, the Clifton Zoological Society, and many travellers and sea-captains have contributed. In Zoology it contains many valuable specimens, such as the large Gorilla from the River Gaboon, W. Coast of Africa, both the skeleton and stuffed skin being well preserved; the fine skeletons of *Manatus australis* and *otaria* from the Chilean coast; the ancient Peruvian human skulls from Arica and Islay; the very large Green Turtle's skeleton from Ascension Island. The fossil collection is still more notable, for it contains many unique and type-species of carboniferous fishes. The grand collection of *Ceratodus* teeth, rescued recently from purchase by Americans, is placed close to a specimen of *Ceratodus forsteri* from Australia, with jaws and teeth detached. The additions to the Museum buildings now in course of erection, which include the fine lecture-theatre in which Section C is accommodated, have enabled the local committee to find room for a local loan collection of natural history, in which Bristol ornithology and entomology are specially well represented.

The rich local flora is well represented by the efforts of the botanical members of the Naturalists' Society. Sixty comparatively rare species are exhibited. A convenient handbook to the local museum and temporary additions has been published. Messrs. Tawney, Stoddart, Wheeler, Derham, and many others have worked zealously to make this one of the most successful of the *et ceteras* at this meeting.

The temporary museum of objects illustrating papers



or reports read before the Sections, has been well stocked, and superintended by Mr. J. E. Taylor.

In accordance with resolutions presented at the Belfast meeting, the Council this year memorialised Government to take action in reference to several subjects connected with the advancement of science. First, in March this year, Prof. Tyndall addressed Government in the name of the Council, urging upon them the desirableness of continuing solar observations in India. In accordance with this request, Lord Salisbury urged upon the Governor-General of India the advisability of establishing at Simla a Solar Observatory to continue the work which is to be carried on at Roorkee in 1875-6. Secondly, the Council urged upon Government the importance of appointing naturalists to vessels engaged on the coasts of little-known parts of the world. The Admiralty thanked the Council for their suggestion. The third resolution was that the Council be requested to take such steps as they may think desirable with the view of promoting any application that may be made to her Majesty's Government by the Royal Society for a systematic physical and biological exploration of the seas around the British Isles. The Council have deferred the consideration of this resolution until action be taken by the Royal Society. The fourth resolution supported the equipment of an Arctic Expedition: with what success the efforts in this direction have been crowned, everybody knows.

The balance-sheet of the Association for 1874-5 shows a balance in hand, at the commencement, of 714*l.*; receipts from subscriptions, 2,324*l.*; dividends, 238*l.* Payments were—for Belfast meeting, 405*l.*; Report of Bradford meeting, 689*l.*; salaries, 470*l.*; rent, &c., 104*l.*; grants, 960*l.*; balance in hand, 624*l.* The estimate for 1875-6 was as follows:—Receipts at Bristol, 2,316*l.*; supposed additional members' subscriptions, 230*l.*; total estimated income, 3,438*l.*; probable expenses at Bristol, 430*l.*; printing Belfast Report, 720*l.* A balance of 1,713*l.* was shown, from which grants might be made. The number attending the meeting is approximately as follows:—Life members, 265; annual members, 385; associates, 860; ladies, 670; foreign members, 16; total, 2,196. Number at Belfast, 1,938.

Glasgow has been chosen as the place of meeting for next year, and Plymouth for 1877.

Sir Robert Christison has been chosen President-elect of the meeting at Glasgow. The Vice-presidents for the Glasgow meeting were elected as follows:—The Duke of Argyll, Sir W. Stirling Maxwell, Sir William Thomson, the Lord Provost of Glasgow, Dr. Allen Thomson, and Prof. A. C. Ramsay. The general secretaries and treasurer were re-appointed, and the Glasgow meeting was fixed to commence on Wednesday, Sept 6, 1876.

## REPORTS

*The Report of the Committee on Specific Volumes*, consisting of Professors Roscoe, Balfour Stewart, and Thorpe, was presented by Dr. Thorpe.—The committee have undertaken to report on the validity of Kopp's laws concerning the specific volumes of liquids. The greater portion of the experimental part of the investigation has been finished, but the reduction and calculation of the results have still to be completed, and the committee will not be able to present their final report until the next meeting of the Association.

*Report on Dredging off the Coast of Durham and North Yorkshire in 1874*, by David Robertson and G. S. Brady.—The greatest number of novelties occurred among the Copepoda, twenty-eight species being new to science, and eleven others new to British records. Twenty-one species are added to the list of testaceous mollusca prepared by the late Mr. Alder; other orders afforded new species. Much interesting information was obtained about the distribution of the species. While the testaceous mollusca show distinctly boreal characters, in the Ostracoda and Foraminifera this is by no means so apparent. The

reporters do not suppose that a cold arctic current is the only or even perhaps the chief agent in the continued existence of this peculiar Northumbrian molluscan fauna; consequently some more local circumstances must be looked to as the chief causes of the retention of the species in question over particular circumscribed areas. Copious particulars of the dredgings are given, with full lists of species.

*Report on the Zoological Station at Naples.*—At present the station possesses twenty-one working tables, of which seventeen are occupied or bespoken. Each table is in itself a condensed laboratory; it is supplied with a number of small working aquaria, with a constant stream of sea-water. The animals for study are provided by the station. The large aquarium of the station can also be used by students for suitable purposes. The library has already become a fairly extensive one, being especially rich in embryological works. Students may accompany and take part in the fishing and dredging expeditions of the station. The large aquarium is partly a popular exhibition, which helps to support the station. The staff consists of Dr. Dohrn, the general director; Dr. Eisig, his responsible assistant; two other scientific assistants, one to superintend the large aquarium and the fishing, and the other to arrange for the collection and preservation of animals; three engineers, four house servants, and four fishermen. The work facilitated by the station is of the following kinds:—1. Morphology and embryology of marine animals; this requires that students should visit the laboratory at the periods when the specimens required can be obtained. 2. Physiological investigation of marine animals, so little worked at hitherto. 3. Study of the habits of marine animals. 4. Systematic investigation of marine fauna and flora of the Mediterranean in the vicinity of Naples. Few tasks are more promising than a thoroughly systematic dredging of the Bay of Naples. Animal forms naturally occupy the chief attention at the station, but no less facilities are offered for the study of marine vegetable forms. This is significantly indicated by the fact that Prof. Cohn, of Breslau, and Prof. Reineke, are to visit the station next session to carry on algological researches. 5. Physical investigation of the sea in the neighbourhood of Naples, with the periodic appearance and disappearance of certain animals in shoals or large numbers. 6. Experiments on breeding and preserving delicate marine organisms in a healthy condition. 7. Transmission of specimens to investigators at home.

The scientific results of the station have been very considerable, and the students have included some of the most distinguished biologists. Next winter Dr. Dohrn proposes to begin a series of annual accounts of the work done at the station. When all the tables are taken up, it is calculated that with strict economy the institution will pay its working expenses. But it would be of the highest value if governments, universities, and public institutions would support the station to a much greater extent than at present.

*Intestinal Secretion.*—A second report was presented by the Committee on Intestinal Secretion—Dr. Brunton and Dr. Pye Smith. The report detailed a number of experiments which the committee had undertaken, and which were considered to prove the absence of influence on Intestinal Secretion through the splanchnic nerves, the pneumogastrics, the sympathetic above the diaphragm or the spinal marrow; and the probable influence of the ganglia contained in the solar plexus, though certainly not of the two semilunar ganglia exclusively. Also the independent occurrence of hæmorrhage and of paralytic secretion appeared, in the view of the committee, to point to a separate nervous influence on the blood-vessels and the secretory structures of the intestines. They also observed the occurrence of vomiting after section of both splanchnics and vagi.

## SECTIONAL PROCEEDINGS

### SECTION A—MATHEMATICS

The Section was well filled to hear Prof. Balfour Stewart's address, in spite of the great counter attraction offered by Mr. Froude's address and experiments which were taking place simultaneously in the room underneath, Section G. After the conclusion of the address, and after a cordial vote of thanks, moved by Col. Strange and seconded by Rev. R. Mason, had been accorded to Prof. Stewart, Prof. Everett gave in a few words the report of the Underground Temperature Committee, specially referring to the observations recently made at the St. Gothard Tunnel, at Chiswick, and at Swinderby near Lincoln. Prof. Guthrie then showed his experiments on the measure-

ment of the rate of wave progress. His apparatus consisted of three deep troughs, two circular and one rectangular, and the steadiness of the motion in each was remarkable; he compared the velocities of the waves with the times of vibrations of pendulums, and verified that in different sized troughs the rate varied inversely as the square root of the diameter. The experiments excited a good deal of interest.

The Rev. S. J. Perry, of Stonyhurst College (one of the members of the expedition to Kerguelen to observe the Transit of Venus), read a paper on that event. Father Perry illustrated his remarks by diagrams of the sun and the planet, as seen from various stations, and gave a very interesting explanation which was attentively listened to. He said that although much prominence had not been given to the idea, he believed that a very important reason why so much expense was gone into in the expedition was that the distance of the earth from the sun entered into the calculation of lunar tables. The observations were not of any striking nature; they were simply to watch a black spot pass across the sun. There was nothing exciting about it, except that when the observations had to be taken they had to be very careful about the precise time, and they had to observe the spot during the whole time of its passage. Having pointed out with reference to his diagrams the reason why the different stations were chosen, he denied the assertions that had been made that Sir George Airy neglected Halley's method of observation for Delile's; the truth was he had rightly decided in favour of Delile, but he had not neglected Halley. With regard to the (Halleyan) stations in the extreme north, they were left to the care of the Russians, and the English, French, Americans, Germans and others occupied in the southern hemisphere. As it was mid-winter, the sun was very nearly on the line of the southern tropics and nearly vertical at ingress over the eastern border of Australia. There were primarily five English Government expeditions, but as these were subdivided, there were, including private observers and those of India and the Colonies, about twenty English stations of observation. His station was Kerguelen, to the south-west of Australia, and after arriving there they found that the Americans had taken the station recommended by the members of the *Challenger* Expedition, but in spite of that they had plenty of time to look about the island (which was a very barren place, about ninety miles by forty-five), and they were fortunate enough to get a much better position than the Americans, after all, by going a little to the south-west. They had been told before they went out that there was always a mist over the island, but, though that might be the case in the north of the island, which had been chiefly visited before, it did not apply to the south while they were there, and they had not more mist than there would have been in London. On the morning of the transit, which they expected to begin at 6:30, they rose at four, and at once made preparations for the day's work. They were divided into three parties, and were so placed that, with the Americans, they formed four parties, about eight miles distant from each other. They saw the sun very well until after six o'clock, at the first (his own) station, until almost the time that Venus was coming on to the sun's disc, and they had the external contact as well as could be expected, for there never could be absolute certainty with regard to such a point. They continued very well until they had taken the bisection by the planet of the sun's disc, but then there was just one little cloud that came and placed itself right over the planet and remained till ten minutes after the commencement of the transit. At the other stations they were able to make observations of the ingress. At his station they were able to get observations of the internal and external contact at egress, and a few photographs. Father Perry added particulars of the result of observations at the other stations as far as could be ascertained, and narrated his experience of a cyclone in the Indian Ocean on the homeward passage. He added that during their stay on the island they not only made astronomical observations, but also a series of magnetic and meteorological observations; and the Rev. A. E. Eaton was sent by the Royal Society to study the botany of the island.

In answer to a gentleman, Father Perry said if they got the results of the observations in seven years' time they would be very lucky, as they had first to determine their longitude, and that occupied a very long time.

Prof. Osborne Reynolds read a paper *On the Refraction of Sound by the Atmosphere*, in which he remarked that in previous papers he had pointed out that the upward diminution of temperature in the atmosphere (known to exist under certain

circumstances by Mr. Glaisher's balloon ascents) must refract and give an upward direction to the rays of sound which would otherwise proceed horizontally, and it was suggested that this might be the cause of the observed difference of the distinctness with which similar sounds were heard on different occasions, particularly of the very marked advantage that the night has over the day in this respect. On this subject he had made a series of experiments. He mentioned a case in which at sea, when leaving a yacht in a small boat, for the purpose of making experiments on sound, those in the yacht and the boat were able to call to one another, and he heard at a distance of three-and-a-half miles, and that the hiss and report of a rocket sent up from the yacht was heard at a distance of five miles. Also on the same occasion the barking of a dog on shore, which was eight miles distant, was heard, and the paddles of a steamer which must have been fifteen miles off were distinctly audible. Prof. Reynolds remarked that the distinctness with which sounds of such comparatively low intensity could be heard was perhaps beyond anything definitely on record, although remarkable instances of sounds heard a long way off were occasionally heard. As the result of a series of experiments made by means of an electric bell, Prof. Reynolds found that when the sky was cloudy and there was no dew, the sound could invariably be heard much further with than against the wind; but when the sky was clear, and there was a heavy dew, the sound could be heard as far against a light wind as with it. On one occasion in which the wind was very light and the thermometer showed 39° at one foot above the grass, and 47° at eight feet, the sound was heard 440 yards against the wind and only 270 yards with it.

The paper by Prof. G. G. Stokes and Dr. J. Hopkinson, *On the Optical Properties of a Titano-silicic Glass*, we give in extenso on account of its importance. At the meeting of the Association at Edinburgh in 1871, Prof. Stokes gave a preliminary account of a long series of experiments in which the late Mr. Vernon Harcourt had been engaged, on the optical properties of glasses of a great variety of compositions, and in which since 1862 Prof. Stokes had co-operated with him.\* One object of the research was to obtain, if possible, two glasses which should achromatize each other without leaving a secondary spectrum, or a glass which should form with two others a triple combination; an objective composed of which should be free from defects of irrationality without requiring undue curvature in the individual lenses. Among phosphatic glasses, the series in which Mr. Harcourt's experiments were for the most part carried on, the best solution of this problem was offered by glasses in which a portion of the phosphoric was replaced by titanic acid. It was found, in fact, that the substitution of titanic for phosphoric acid, while raising, it is true, the dispersive power, at the same time produces a separation of the colours at the blue, as compared with those at the red end of the spectrum, which ordinarily belongs only to glasses of a much higher dispersive power. A telescope made of discs of glass prepared by Mr. Harcourt, was, after his death, constructed for Mrs. Harcourt by Mr. Howard Grubb, and was exhibited to the Mathematical Section of the late meeting in Belfast; this telescope, which is briefly described in the Report,† was found fully to answer the expectations that had been formed of it as to destruction of secondary dispersion.

Several considerations seemed to make it probable that the substitution of titanic acid for a portion of the silica, in an ordinary crown glass, would have an effect similar to that which had been observed in the phosphatic series of glasses. Phosphatic glasses are too soft for convenient employment in optical instruments, but should titano-silicic glasses prove to be to silicic what titano-phosphatic glasses have been found to be to phosphatic, it would be possible, without encountering any extravagant curvatures, to construct perfectly accurate combinations out of glasses having the hardness and permanence of silicic glasses; in fact, the chief obstacle at present existing to the perfection of the achromatic telescope would be removed, though naturally not without some increase to the cost of the instrument. But it would be beyond the researches of the laboratory to work with silicic glasses on such a scale as to obtain them free from striae, or even sufficiently free to permit of a trustworthy determination of such a delicate matter as the irrationality of dispersion.

When the subject was brought to the notice of Mr. Hopkinson, he warmly entered into the investigation, and thanks to the liberality with which the means of conducting the experiments

\* Report for 1871. Transactions of the Sections, p. 38.

† Ditto for 1874. Transactions of the Sections, p. 26.



were placed at his disposal by Messrs. Chance Brothers, of Birmingham, the question may perhaps be considered as settled. After some preliminary trials, a piece of glass free from striae was prepared of titanate of potash mixed with the ordinary ingredients of a crown glass. As the object of the experiment was merely to determine in the first instance whether titanic acid did or did not confer on the glass the universal property of separating the colours at the blue end of the spectrum materially more, and at the red end materially less, than corresponds to a similar dispersive power in ordinary glasses, it was not thought necessary to employ pure titanic acid; and rutile fused with carbonate of potash was used as titanate of potash. The glass contained about seven per cent. of rutile, and as none was lost, the percentage of titanic acid cannot have been much less. The glass was naturally greenish from iron contained in the rutile; but this did not affect the observations, and the quantity of iron would be too minute sensibly to affect the irrationality.

Out of this glass two prisms were cut. One of these was examined as to irrationality by Prof. Stokes, by his method of compensating prisms; the other by Mr. Hopkinson, by accurate measures of the refractive indices for several definite points in the spectrum. These two perfectly distinct methods led to the same result, viz., that the glass spaces out the more as compared with the less refrangible part of the spectrum no more than an ordinary glass of similar dispersive power. As in the phosphatic series, the titanium asserts its presence by a considerable increase of dispersive power; but, unlike what was observed in that series, it produces no sensible effect on the irrationality. The hopes therefore that had been entertained of its utility in silicic glasses prepared for optical purposes appear doomed to disappointment.

A paper was read by Mr. J. A. Fleming, *On the Decomposition of an Electrolyte by Magneto-electric Induction*. When a solid conductor is moved in a magnetic field induced currents are created in it. In a solid these expend themselves partly or wholly in producing heat in the conductor. The paper was occupied with an examination of the effect produced on electrolytes under the same circumstances, viz., when made to flow or move in a magnetic field: experiments were described to show first that induced currents are produced under these conditions in electrolytes, and then that the electrolyte is to some extent decomposed by these currents.

Dr. Moffat, in his paper *On the apparent connection between Sunspots, Atmospheric Ozone, Rain, and Force of Wind*, stated that in discussing ozone observations from 1850 to 1869, he had observed that the maxima and minima of atmospheric ozone occurred in cycles of years, and that he had compared the number of new groups of sunspots in each year of these cycles with the quantity of ozone, and the results showed that in each cycle of maxima of ozone there is an increase in the number of new groups of sunspots, and in each cycle of minima a decrease. He also gave a table to show that the years of maximum ozone and number of sunspots were generally distinguished by an increase in the quantity of rain and the force of the wind.

Sir W. Thomson's paper *On the effects of Stress upon the Magnetism of Soft Iron* was a continuation of two that had been read before the Royal Society. In the physical laboratory at Glasgow University he had stretched steel and soft iron wire about twenty feet long from the roof. An electro-magnetic helix was placed round a few inches of the wire, so that the latter could be magnetised when an electric current was passed through the former; the induced current thus produced in a second helix outside the first being indicated by a reflecting galvanometer. When steel wire was used, the magnetism diminished when weights were attached to the wire, and increased when they were taken off; but when specially made soft iron wire (wire almost as soft as lead), the magnetism was increased when weights were put on, and diminished when they were taken off. Afterwards he discarded the electrical apparatus, and by suspending a piece of soft iron wire near a magnetometer consisting of a needle, a small fraction of a grain in weight, with a reflecting mirror attached, the wire was magnetised inductively simply by the magnetism of the earth, and changes in its magnetism were made by applying weights and strains, the changes being then indicated by the magnetometer.

Prof. W. F. Barrett read a paper *On effects of Heat on the molecular structure of Steel Wires and Rods*, in the course of

which he said he found that if steel of any thickness be heated by any means, at a certain temperature the wire ceases to expand, although the heat be continuously poured in. During this period also the wire does not increase in temperature. The length of time during which this abnormal condition lasts varies with the thickness of the wire and the rapidity with which it can be heated through. It ceases to expand, and no further change takes place till the heat is cut off. When this is done the wire begins to cool down regularly till it has reached the critical point at which the change took place on heating. Here a second and reverse change occurs. At the moment that the expansion occurs, an actual increase in temperature takes place sufficiently large to cause the wire to glow again with a red-hot heat. It is curious that this after-glow had not been noticed long ago, for it is a very conspicuous object in steel wires that have been raised to a white heat and allowed to cool.

Mr. Braham exhibited some experiments on magnetised rings, plates, and discs of hardened steel, and also experiments on air, hydrogen and oxygen.

## SECTION D.

### BIOLOGY.

OPENING ADDRESS BY DR. P. L. SCLATER, M.A., F.R.S., F.L.S., PRESIDENT.

#### *On the Present State of our Knowledge of Geographical Zoology.*

In the office, which I have now held for more than sixteen years, of Secretary to the Zoological Society of London, I have been not unfrequently requested by our members and correspondents in various parts of the world to furnish them with information as to the best works to be consulted on the zoology of the countries in which they are respectively resident, or which they are about to visit. With the well-furnished library of the Zoological Society at my command this is not usually a very difficult task, so far as publications are actually in existence to supply the desired information. I am also frequently asked to point out the principal deficiencies in our knowledge of the animals of particular countries. This is also a not very difficult request to reply to, although it is somewhat embarrassing on account of the very imperfect information which we still possess of geographical zoology generally, and the largeness of the claims I am therefore constrained to put forward for the attention of those who make such inquiries. Great, however, has been the progress made of late years towards a more complete knowledge of the faunas of the various parts of the world's surface. Expeditions have been sent out into countries not previously explored; collections have been formed in districts hitherto little known; and many general works have been published, combining the results of previous fragmentary knowledge on this class of subjects. Under these circumstances I have thought that such an account as I might be able to give of the general progress that has been recently made towards a better knowledge of the zoology of the various parts of the earth's surface, accompanied by a series of remarks upon the best available authorities to be consulted upon such subjects, might supply a want which, as above mentioned, I know by personal experience is often felt, and at the same time would form a not inappropriate address from the chair which I have now the honour to occupy.

I must premise, however, that my observations must be restricted mainly to the terrestrial members of the sub-kingdom Vertebrata. To review the recent progress of our knowledge of the various sections of invertebrate animals in different countries would be beyond my powers, and would inordinately enlarge my subject. Besides, it is certain that the higher classes of animals have occupied the principal attention of recent writers on geographical zoology, and it is with their distribution that we are best acquainted.

Taking, therefore, the seven great regions into which the earth's surface may be most conveniently divided for zoological purposes one after another, I will endeavour to point out our leading authorities on the Mammals, Birds, Reptiles, Batrachians, and Fishes of each of them, and their main constituent parts. At the same time, I will endeavour to indicate the principal deficiencies in our knowledge of these subjects, and may perhaps be able to add a few suggestions as to how some of these deficiencies might be best overcome.

In these remarks I will take the divisions of the earth's surface

in the same order as I have generally used in my lectures on zoological geography, namely:

- |                              |                       |
|------------------------------|-----------------------|
| I.—Palæarctic Region         | } <i>Arctogæa.</i>    |
| II.—Ethiopian Region         |                       |
| III.—Lemurian Sub-region     |                       |
| IV.—Indian Region            |                       |
| V.—Neartic Region            | } <i>Dendrogeæa.</i>  |
| VI.—Antillean Sub-region     |                       |
| VII.—Australian Region . . . | } <i>Antarctogæa.</i> |
| VIII.—Pacific Region . . .   |                       |

#### I.—THE PALÆARCTIC REGION.

The Palæarctic Region I shall consider for convenience sake in the following seven sub-regions:—

1. The *Cisatlantic Sub-region*, embracing all that part of the Palæarctic Region lying south of the Mediterranean Sea.
- 1a. The Atlantic Islands.
2. The *European Sub-region*.
3. The *Siberian Sub-region*, embracing the whole of Northern Asia.
4. The *Manchurian Sub-region*, containing Northern China and the adjoining part of Mongolia.
5. The *Japanese Sub-region*, embracing the Japanese Islands.
6. The *Tartarian Sub-region*, containing the great desert-region of Central Asia.
7. The *Persian Sub-region*, embracing Persia, Asia Minor, and Syria.

##### I. THE CISATLANTIC SUB-REGION.

As regards the zoology of the main western portion of this district (Tunis and Algeria) our knowledge may be now said to be pretty far advanced. The standard work on the subject is the "Exploration Scientifique de l'Algérie" published by the French Government, in which are treatises on the Mammals and Birds of Algeria by Loche, and on the Reptiles and Fishes by Guichenot. This work was commenced in parts in 1840, and the portions relating to the Mammals and Birds were, I believe, intended to have been written by M. Vaillant, the artist of the Commission; but only the plates were issued, and the text by Captain Loche was not completed until 1867. A smaller and more convenient work for travellers is the last-named author's catalogue of the Mammals and Birds of Algeria, published in 1858.

As regards the herpetology of Algeria, an excellent memoir on this subject by Dr. Alexander Strauch will be found in the fourth volume of the new memoir of the Academy of St. Petersburg. Those who penetrate beyond the Atlas will find the lists of the vertebrate animals appended to Canon Tristram's "Great Sahara" very useful. Many interesting details about the birds of Tunis and Algeria will likewise be found in the papers communicated to the "Ibis," by Messrs. Salvin, Tristram, and J. H. Gurney, jun.

Of Morocco and the extreme western portion of the Atlas, our knowledge is as yet by no means so perfect. As regards the birds of Tangier and its vicinity, we have Colonel Irby's lately published volume on the Ornithology of the Straits of Gibraltar, in which the "observations on the Moorish birds are in a great measure culled from the MSS. of the late M. Favier—a collector long resident in Tangier." But in the south of Morocco, in the Western Atlas and surrounding district, there is certainly a considerable *terra incognita* within easy reach of England, which has hitherto been almost inaccessible to naturalists, though the short expedition of Dr. Hooker, Mr. Maw, and Mr. Ball in 1871 (of which a notice only has been published, but a complete scientific account is, I believe, in preparation), shows that it may be penetrated if proper precautions are taken.

##### 1a. The Atlantic Islands.

The Atlantean island-groups of the Canaries, Madeira, and the Azores, may perhaps be most naturally appended to this division of the Palæarctic Region. Our knowledge of the fauna of each of these three groups is tolerable; although there is of course much to be done in working up details. As regards the Canaries, the standard work is Webb and Berthelot's "Histoire Naturelle des Iles Canaries," published at Paris under the auspices of the Minister of Public Instruction. Dr. Carl Bolle has visited the group more recently, and written several excellent articles in Cabanis's Journal on their ornithology.

Madeira has had the advantage of the residence of several

first-class English naturalists—I need only mention the names of Lowe, Vernon, Wollaston, and Johnson, to establish this point. More than twenty years ago Mr. E. W. Harcourt, in his "Sketch of Madeira," and in contributions to the "Proceedings of the Zoological Society," and "Annals of Natural History," gave us a good account of the ornithology of Madeira. Mr. F. Godman has recently published an excellent article on the Birds of Madeira and the Canaries in the "Ibis" for 1872, in which a complete *résumé* is given of the whole of our previous knowledge of this subject, together with the information obtained by the author himself during his expedition to these islands in 1871.

As regards the fishes of Madeira, they have formed a subject of study of several excellent ichthyologists. The Rev. R. T. Lowe made numerous communications to the Zoological Society of London upon them in the early days of the Society, and published in their "Transactions" a Synopsis of Madeiran Fishes, to which divers supplements were afterwards added. Subsequently Mr. J. Y. Johnson took up the subject and made numerous additions to Mr. Lowe's experiences, which were mostly published by the same Society. Dr. Günther has likewise contributed to our knowledge of Madeiran fishes, so that on the whole there is, perhaps, hardly any locality out of Europe with the ichthyology of which we have a better general acquaintance.

For our knowledge of the higher animals of the third island-groups above spoken of, that of the Azores, we are mainly indebted to the energy of Mr. F. D. Godman, who made a special expedition to those islands in 1865, with the object of studying their fauna. The results are embodied in his volume on the Azores, published by Van Voorst in 1870. Morelet's work on the Azores, previously published, is mainly devoted to the Land-shell. Mr. Godman is almost the only authority upon the Mammals, Birds, and other Vertebrates.

##### 2. THE EUROPEAN SUB-REGION.

To discuss, or even to give the titles of, all the works that have been published on the Vertebrates of Europe would extend this address to far beyond its proper limits. I must content myself with a few words on the principal works which have appeared of late years—first, upon the Zoology of Europe generally, and secondly, upon the Faunas of its chief political divisions.

##### A. Mammals of Europe.

To begin with the Mammals, our standard authority upon the European members of this class is Blasius's "Naturgeschichte der Säugethiere Deutschlands und der angrenzenden Länder," and an excellent work it is. Unfortunately, however, it does not extend into Southern Europe, where alone many of the more interesting forms of European Mammal-life make their appearance. A work founded on Blasius's volume and embracing the additional species of Mammals to be met with in Spain, Italy, and Turkey is very desirable, and it is with great pleasure that I have been informed that an energetic member of this Association has already set some such undertaking before him. The only work of reference of this extent that I am at present acquainted with is Lord Clermont's useful "Guide to the Quadrupeds and Reptiles of Europe," published in 1859. As regards the constituent countries of the European Sub-region, there are but few recommendable works devoted to the illustration of their Mammal-faunas. In England we have Bell's "British Quadrupeds," belonging to Mr. Van Voorst's excellent series. This remained long out of print, until its recent re-issue in 1874 by the author, with the assistance of Mr. R. F. Toms and Mr. Alston. For France, M. Gervais's "Zoologie et Paléontologie Française" enumerates both recent and fossil Mammals, though most regard is paid to the extinct fauna. As regards Spanish Mammals, almost the only authority I am acquainted with is Rosenhauer's "Thiere Andalusiens" which is, however, very defective, the author having devoted himself principally to the study of the Invertebrates. Captain Cork (afterwards Widdrington) was the original discoverer of several of the rarer Mammals of Spain; but the account of them in his "Sketches" is very meagre. A bare list of the Mammals of Portugal is given by Prof. Barboza de Bocage in the "Revue Zoologique" for 1863. Passing over to Italy, Bonaparte's "Fauna Italica" and Costa's "Fauna del Regno di Napoli" must be mentioned, though both are somewhat out of date. But the former work is still the only authority on certain of the rarer Italian species and local form.



A recent summary of Italian Mammals has been given by Prof. Cornalia in "Italia;" but on the whole it must be allowed that a good work upon the Mammals of the Italian peninsula is still a desideratum. Of the Mammals of Switzerland, on the other hand, we have an excellent recent work by Dr. Fatio, forming the first volume of his "Faune des Vertébrés de la Suisse," in which special attention is devoted to the difficult groups of Rodents and Insectivores. No student of the European Mammal-fauna should omit to consult it.

Passing to Eastern Europe, we find our state of exact knowledge as to the Mammals very defective. As regards Greece, we may refer to the French "Expedition Scientifique en Morée," in which there is a memoir on the Mammals by Geoffroy St. Hilaire, and Erhard's "Fauna der Cycladeen," which gives some details on the Mammals of the Greek Archipelago. Of Turkey we find very little information, and there is certainly still much to be done as regards the smaller Mammals of this part of Europe. In Russia we have Ménétriés's "Catalogue of the Animals of the Caucasus," and P. Demidoff's "Voyage dans la Russie Méridionale," and perhaps other works in the language of the country, which I am not acquainted with. But there can be no doubt that it is in South-eastern Europe that our knowledge of the Mammal-fauna of this continent is exceedingly defective, and that much remains to be done in order to complete our acquaintance with this branch of European Zoology.

In Northern Europe, which we now turn to, the case is quite different. The highly cultivated and laborious naturalists of Scandinavia have for many years paid great attention to this as to every other part of their fauna. The first volume of Nilsson's "Scandinavian Fauna," published at Lund in 1874, has long been a standard book of reference on this branch of zoology. Much, however, has been done since that period; and in Prof. Lilljeborg's lately issued work on the Mammals of Sweden and Norway, we have an exhaustive account of the present state of our knowledge of this subject.

As regards the few Mammals of Spitzbergen, reference should be made to the second volume of Heuglin's "Reisen nach dem Nordpolarmeer," where that energetic naturalist has put together an account of the nineteen species of Mammals that penetrate so far north.

#### B. Birds of Europe.

(a.) *Europe generally.*—There can be no question, I suppose, that the attractive class of Birds has received much more attention than its sister-classes of Vertebrates in Europe as generally elsewhere. Of late years especially a considerable number of naturalists in almost every part of this continent have devoted their principal attention to ornithology. Two journals are devoted solely to this science—in which the larger number of articles treat of the birds of some portion or other of Europe. The mass of literature on the subject is large, and I must therefore be rather concise in my notices of the principal modern authorities that should be referred to by an inquirer on the subject of European Ornithology.

First, as to the avifauna of the whole continent, Temminck's "Manual"—long the acknowledged authority on this subject—was superseded in 1849 by the issue of Degland's "Ornithologie Européenne." The new edition of this work, issued by the author and Gerbe jointly in 1867, is perhaps now the most complete book of its kind. But it has great faults and imperfections, particularly as regards its indications of the distribution of the species. This branch of the subject had never been properly worked until the recent issue of Mr. Dresser's (formerly Sharpe and Dresser's) "Birds of Europe," which contains, so far as it has hitherto progressed, by far the most exhaustive account of the European birds yet attempted. Its large size and numerous illustrations, however, render it rather cumbersome as a manual; but a handbook based on it when completed, and containing a judicious abridgment of its information (which I hope Mr. Dresser will not fail to prepare), will, I am sure, form a most valuable work.

Fritsch's "Naturgeschichte der Vögel Europas," lately published at Prague, is a cheap and useful manual for those who understand German; while Gould's "Birds of Europe," though out of date, will be always referred to for its illustrations.

(b.) *Birds of Great Britain.*—For many years the standard book of reference on the ornithology of these islands has been Yarrell's "British Birds," and its several Supplements. The new edition of this work, commenced in June 1871 by Prof. Newton, is familiar, no doubt, to most of the mem-

bers of Section D. As to its merits there can be no question; I think it is seldom indeed that a task is entrusted to one so thoroughly competent to perform it, or so careful in the execution of what he undertakes. But the slow progress of the work is appalling. After four years only one of the promised four volumes has been completed. As amongst the best of numerous local works on the birds of this country recently issued should also be mentioned Gray's "Birds of the West of Scotland," and Hancock's memoir on those of Northumberland and Durham. A very useful work of reference for ornithologists is also Mr. Harting's "Hand-book of British Birds," in which the exact dates and places of occurrence of all the rarer visitants are recorded. Those who love life-sized illustrations, and have full purses, will not fail to acquire (provided a copy is left) Mr. Gould's splendid work on the "Birds of Great Britain," now complete in five volumes. After this enumeration it will be almost needless to remark that Ornithology has no reason to complain of want of support in this country.

(c.) *Birds of France.*—In France less attention has been devoted to the native birds of late years; and besides the new edition of Degland's "Ornithologie Européenne" already spoken of, I have only to mention Bailly's "Ornithologie de la Savie," and Jaubert and Barthélemy-Lapommeraye's "Richesse Ornithologique de la Midi de la France," in each of which will be found much information about the rarer birds of the districts respectively treated of.

(d.) *Birds of Spain and Portugal.*—Much attention has been paid to the avifauna of Southern Spain of late years, but rather by visitors from the north than by native naturalists. Lord Lilford and Mr. Howard Saunders have both given us some excellent articles in the "Ibis" on this subject, and have made a variety of interesting discoveries, amongst which are actually several new species,\* or at all events well-marked local forms. Dr. A. E. Brehm, long resident at Madrid, has also devoted much attention to Spanish ornithology, and written a complete list of Spanish Birds, which should be consulted. To Colonel Irbys work on the Straits of Gibraltar I have already alluded; as regards the southern extremity of the peninsula he is our best and most recent authority. For information on the birds of Portugal we must again go to an English source—Mr. Alfred Charles Smith, "Narrative of his Spring Tour" being the best authority which I am acquainted with on this subject.

(e.) *Birds of Italy.*—Savi's "Ornithologia Toscana," published as long ago as 1827, was for long almost our only authority on Italian ornithology. Bonaparte's "Iconographia," already alluded to, gave some additional information as to rarer species. Salvadori's memoir on the birds, forming the second volume of the recently published "Fauna d'Italia," is the best and most recent authority on this subject, and contains an excellent "Bibliografia Ornithologica Italiana." A large illustrated work on the birds of Lombardy has been recently published at Milan by Bettoni. We must also call attention to the persevering way in which Mr. C. A. Wright has worked up the Avifauna of Malta, and to Mr. A. B. Brooke's recently published notes on the Ornithology of Sardinia.

(f.) *Birds of Turkey and Greece.*—Dr. Krüper, a well-known German naturalist, has been long resident in various parts of the Levant, and has contributed numerous articles upon the birds met with to various periodicals. These have been recently put together and edited by Dr. Hartlaub, and published as a number of Mommser's "Griechische Jahreszeiten," which thus contains a summary of all our principal information on the birds of Greece and its islands. Before that our best authority on Grecian birds was Lindermayer's "Vögel Griechenlands." As regards European Turkey, Messrs. Elwes and Buckley have lately published a good paper in the "Ibis" on its birds; and MM. Alléon and Vian have written several articles in the "Revue Zoologique" on the ornithology of the neighbourhood of Constantinople. But there is certainly still much to be done as regards birds in this part of the continent, as likewise amongst the islands of the Greek Archipelago, many of which are almost unexplored by the naturalist.

(g.) *Birds of Southern Russia and the Caucasus.*—Though many notices of the birds of Southern Russia have appeared in the "Bulletin" of the Society of Naturalists of Moscow, I am not aware of any complete account of them having been issued. Demidoff, in the third volume of his "Voyage dans la Russie Méridionale," gives a list of the birds of what he calls the

\* *Gecinus Sharpii*, P.Z.S. 1872, p. 153, and *Calendrella betica*, Dresser, "Birds of Europe," pt. 21.

"Faune Pontique," but his original observations are somewhat meagre. Eichwald's "Fauna Caspio-Caucasica" and Ménétries's Catalogue of the Zoology of the Caucasus, should also be consulted, although both are rather out of date. An excellent zoologist, Hr. Gustav Radde, is now resident at Tiflis; but I do not think he has yet prepared any general account of the birds of the Caucasus, where there must be certainly much of interest, as is proved by the discovery of the remarkable Grouse, allied to our Black Grouse, which has just been described by M. Taczanowski.\*

(h.) *Birds of Germany and Central Europe*.—Local lists of the birds of the various States of Central Europe, and their principal divisions, are very numerous; and there are also many manuals and memoirs on the same subject. But J. A. Naumann's excellent "Vögel Deutschlands," commenced in 1822, with its supplements, is still, I believe, quite unsuperseded as a standard book of reference on Central European Ornithology. It was generally understood that Prof. Blasius, at the time of his lamented death, had a work on the birds of his native country in preparation; but unfortunately this was never finished, or it would have proved to be, no doubt, of first-rate excellence. In no other country, however, except our own, is ornithology so much cultivated as in Germany. Two societies emulate each other in their pursuit of this science, and a special journal is devoted to its progress. There is no lack, therefore, of recent information upon the birds of every part of Germany, although this has to be fished out of journals and periodicals of different sorts, instead of being put together, as we should rather wish to see it, in some general work.

(i.) *Birds of Scandinavia and North Europe*.—In Scandinavia also there is no dearth of diligent observers of birds as of every other class of animals. The bird-volume of Nilsson's Scandinavian Fauna was published in 1858, and is still worthy of careful study. But the more recent works of Collett upon the Birds of Norway, in German and in English, should be consulted, as also Sundevall's "Svenska Foglarna," unfortunately not quite finished at the time of his decease, and Von Wright and Palmén's "Finland's Foglar." Many memoirs have also recently appeared upon the birds of the extreme north, which have always attracted great interest among ornithologists. Amongst these special attention may be called to v. Heuglin's account of the birds of Nova Zembla, first published in Cabanis's Journal for 1872, and afterwards enlarged and revised in the second volume of his "Reisen in dem Nordpolarmeer;" to Prof. Newton's essay on the birds of Iceland in Mr. Baring-Gould's "Iceland, its Scenes and Sagas;" and lastly, to Messrs. Alston and Brown's narrative of their adventures among the birds of Archangel—a little explored district, and one of much promise, to which one of these active explorers has returned this year.

#### C. European Herpetology.

In this field of research there is not so much of recent work to record as among the birds; but Dr. E. Schrieber's "Herpetologia Europæa," which has just appeared, marks an important epoch in this branch of science, since there was previously no good work of reference upon the Reptiles and Batrachians of Europe. Dr. Schrieber's work is drawn up upon the same plan as Blasius's well-known "Säugethiere Europas," and forms a most convenient handbook. The list of published works and memoirs on the same subject prefaced to it renders it unnecessary for me to refer to the previous authorities on European herpetology in detail. I observe, however, that Lord Clermont's very useful "Guide to the Quadrupeds and Reptiles of Europe" is not referred to in the list, and it would appear that Dr. Schrieber is not acquainted with it. I must also call special attention to Dr. Strauch's excellent memoir on the Serpents of the Russian Empire, recently published in the Memoirs of the Imperial Academy of St. Petersburg, which is as important for the European as for the Asiatic part of the Russian dominion. As regards our native Herpetological Fauna also, I may point out that the last edition of Bell's "British Reptiles," published in 1839, requires considerable revision to bring it up to our present standard of knowledge, and that it is much to be desired that a new edition should be undertaken. Let me venture to suggest that Mr. Van Voorst should communicate with Dr. Günther upon this subject.

#### D. European Ichthyology.

I am not aware of the existence of any special work on European Ichthyology, but C. Th. v. Siebold published in 1863 a

volume on the Fresh-water Fishes of Central Europe, which forms a useful guide to the Pisci-fauna of the principal European river-basins. For the fishes of the Atlantic which visit the British coasts we have the third edition of Yarrell's "British Fishes," edited by the late Sir John Richardson, which was published in 1859. Now that Dr. Günther's great general work on Fishes has been completed, this portion of Mr. Van Voorst's excellent series would be also much benefited by revision and rearrangement according to Dr. Günther's modern system and nomenclature. As a cheaper and more popular work we may also refer to Conch's "British Fishes" in four volumes, in which the figures are coloured.

Prof. Blanchard issued in 1866 a volume of the Freshwater Fishes of France, which, however, does not bear so high a character as Siebold's work above referred to. For our knowledge of the fishes of Spain and Portugal we are chiefly indebted to Steindachner's memoirs in the Sitzungsberichte of the Vienna Academy, and to F. de Brito Capello's papers in the *Journal of Sciences of Lisbon*. Of those of Italy, Prof. Canestrini has lately published a revised list with short specific characters, as a portion of the work called "Italia" already referred to. Those interested in the fishes of the Black Sea and adjoining river-basins should consult the ichthyological portion of Demidoff's "Voyage dans la Russie Méridionale," entitled "Pisces Faunæ Ponticæ." I am not acquainted with any other important recent memoirs on the ichthyological faunas of the different European States which it is necessary to refer to until we come to Scandinavia, where Malmgren published in 1863 an excellent essay upon the Fishes of Finland, which was subsequently translated into German. As regards the fishes of Spitzbergen and Nova Zembla, Heuglin's Synopsis of them in the second volume of his already quoted "Reisen nach dem Nordpolarmeer" is the most recent authority, though it is principally founded upon the labours of Lovén and Thorell, and of the naturalists of the Swedish expeditions of 1861 and 1864.

#### 3. THE SIBERIAN SUB-REGION.

When I call to mind the numerous scientific expeditions sent by the Russians into different parts of their recent acquisition in Northern Asia, and turn over the pages of the excellent and instructive work in which the results of these expeditions have been given to the world, I must own to a feeling of indignation at the manner in which such matters are usually dealt with by the Government of this country. In the first place, in order to get such an expedition sent out at all, great exertions and special influence is necessary. The Treasury must be memorialised, the Chancellor of the Exchequer besought, and the Admiralty petitioned, before any grant of money can be sanctioned for the purpose, and even then it is too often bestowed in a niggardly and grudging way. When the expedition returns, similar applications have to be made in order to get the results worked out and properly published, and these are in some cases altogether rejected, so that the money already spent upon collecting becomes virtually thrown away. In Russia, although the nation may be less awake to the claims of science than in this country, the Government is certainly more so; and it is to the scientific men attached to the Government expeditions that we are indebted for nearly all the knowledge we possess of the fauna of Northern Asia. Of the more important reports of the more recent of these expeditions I will say a few words.

Middendorff's "Sibirische Reise," published in 1851, gives an account of the fauna of the extreme north and east of Siberia. The second volume of the zoological portion is entirely devoted to the Mammals, Birds, and Reptiles, and gives full details concerning the structure and habits of the species met with. Of Von Schrenck's "Amur-reise," a volume published in 1859, contains a complete memoir on the Mammals and Birds of the newly acquired district traversed by the Amoor, lying to the south of that investigated by Hr. v. Middendorff. Lastly, two volumes of Radde's "Reisen in dem Süden v. Ost-Sibirien," published in 1862 and 1863, render more perfect our knowledge of the Mammals and Birds of South-eastern Siberia. Hr. Radde's chief observations were made in Transbaikalia, but he incorporates the knowledge accumulated by his predecessors in the surrounding districts, and goes deeply into general results.

Dr. A. v. Middendorff's "Iseiptesen Russlands" should also be consulted by those who wish to understand the migration of birds in Siberia, or indeed throughout the Russian dominions.

\* *Tetrus ulokosiewiczii*, Tacz., P.Z.S., 1875.



## 4. THE MANTCHURIAN SUB-REGION.

Of this district, which embraces the country lying south of the Amoor and the greater part of Northern China, down perhaps to the great river Yang-tze, we have, besides the Russian works lastly spoken of, two principal sources of information. The first of these consists in the researches of Mr. Robert Swinhoe, of H.M. Chinese Consular Service, one of the most industrious and successful exploring naturalists that have ever lived, as is well known to many of my brother members here present. Mr. Swinhoe's memoirs and papers on Chinese Zoology are very numerous, but [his last revised list of the birds of China will be found in the Zoological Society's "Proceedings" for 1871. Père Armand David, a worthy rival of our Consul, has likewise contributed in no small degree to our knowledge of the fauna of Northern China. His journals, containing numerous remarks full of interest, have lately been published in the "*Nouvelle Archives du Muséum d'Histoire Naturelle de Paris*," and M. Alphonse Milne-Edwards's recently completed "*Recherches sur les Mammifères*" contains a section specially devoted to the Mammals of Northern China, which is mainly based on Père David's researches. I shall, however, have again occasion to mention the discoveries of both Mr. Swinhoe and M. David in a subsequent portion of this address.

## 5. THE JAPANESE SUB-REGION.

Temminck and Schlegel's "*Fauna Japonica*" have long been our standard authority upon the zoology of Japan, and not much has been done of late years to perfect it, except as regards the birds. On this branch of our subject some very good articles have been published in the "*Ibis*" by Capt. Blakiston, based upon his researches in Hakodadi; by Mr. Whitely, who was for some time resident along with Capt. Blackiston at the same port; and by Mr. Swinhoe. Reference should also be made to the second volume of Commodore Perry's "*Narrative of the U.S. Expedition to Japan in 1852-54*," wherein will be found articles on the birds collected by Cassin, and on the fishes by Brevoort.

## 6. THE TARTARIAN SUB-REGION.

Into the great desert-region of Central Asia, hitherto almost unknown, except from Eversmann's "*Reise nach Buchara*," which contains a short natural-history appendix, excursions have recently been made from two opposite quarters. The advancing tide of Russian conquest from the north, accompanied, as usual, by its scientific corps, has already made us well acquainted with the zoology of Turkestan. Mr. Severtzoff has unfortunately yielded to the unphilosophical spirit of nationality, which has of late years attained such a monstrous development, and published his "*Turkestantskie Jevotnie*," or review of the distribution of animal life in Turkestan, in his native Russian. But a translation and reproduction of the portion relating to the birds has already appeared in German, and an abstract of it in English is now being given to the world by Mr. Dresser in the "*Ibis*."

From the south, the peaceful embassies of this country to Yarkand have led naturalists into the fringe of the same zoological district. Of the first of these expeditions we have an excellent account as regards the birds by Mr. A. O. Hume, forming the second part of Henderson's "*Lahore to Yarkand*." Sir D. Forsyth's second expedition to Yarkand and Kashgar was accompanied by Dr. Ferdinand Stolzitzska, one of the most accomplished and energetic members of the staff of the Indian Geological Survey, whose life was miserably sacrificed to the hardships encountered on the return. Of this last expedition we have as yet only incomplete accounts,\* but may, I trust, look forward to the publication of an equally interesting volume on the zoological results. The ichthyological part of the collections has, I believe, been entrusted to Dr. F. Day to work out in this country.

## 7. THE PERSIAN SUB-REGION.

Of the Persian or "*Mediterraneo-persic*" Sub-region, as Mr. Elwes prefers to call it,† which may be held to embrace European Turkey, Palestine, and Persia, our knowledge was until recently very limited, and even up to the present day remains very imperfect, considering the proximity of the district to Europe, and the many interesting features which it presents. As regards Palestine, Canon Tristram's energetic researches have done much to remove what has long been a scandal to biblical scholars as well

as to naturalists. His long-promised "*Synopsis of the Flora and Fauna of Palestine*" is, however, not yet issued by the Ray Society, and we must be consequently content with Mr. Tristram's papers on the Birds of the Holy Land in the "*Ibis*" and Dr. Günther's article upon the Reptiles and Fishes in the Zoological Society's "*Proceedings*," until the finished work appears. Of Asia Minor and Armenia it may be said that we are miserably ignorant, Tchihatcheff's desultory account of its natural history in his "*Asie Mineure*" being almost the only authority we have to refer to. Thirty years ago the Zoological Society had two excellent correspondents at Erzeroum—Messrs. Dickson and Ross; and it is a great misfortune that no continuous account was ever prepared of the fine collection which they sent home.\*

As regards Persia, we may hope very shortly to be much more favourably situated. Mr. W. T. Blanford and Major St. John have recently made large zoological collections in various parts of that country, particularly of birds, and it is generally understood that the report of the Persian Boundary Expedition will contain a complete account of the zoology of Persia from Mr. Blanford's accomplished pen. Hitherto we have had to rely on De Filippi's "*Viaggio in Persie*," and other fragmentary sources of information.

## II.—ÆTHIOPIAN REGION.

This region I shall speak of, for convenience sake, under the following six sub-divisions:—

1. *Western Africa*, from the Senegal to the Congo.
2. *South-western Africa*, or Angola and Benguela.
3. *South Africa*.
4. *South-eastern Africa*, from the Portuguese possessions up to the Somali coast.
5. *North-eastern Africa*, including Abyssinia, Nubia, and Egypt.
6. *Arabia*.

## I. WESTERN AFRICA.

The Mammals of Western Africa are certainly not so well known as they should be; and there is no one work which gives an account of them except Temminck's "*Esquisses Zoologiques sur la côte de Guinée*," which is devoted to the collections transmitted to Leyden by Pel, a most energetic and successful Dutch explorer. On the Mammals of Gaboon, Pucheran's article in the French "*Archives du Muséum*," and Du Chaillu's travels and the literature connected therewith, should be consulted.

The birds of Western Africa, on the contrary, have attracted much attention from European naturalists since the time when Swainson published his "*Birds of West Africa*." This work, however, has been quite superseded by Hartlaub's classical "*System der Ornithologie West-Afrikas*," published in 1857. Since that period many memoirs and papers have appeared on the birds of various parts of this district, principally by Cassin, of Philadelphia, Dr. Finsch, of Bremen, and Mr. R. B. Sharpe, of the British Museum, who has paid special attention to the African Ornithology, and is understood to be preparing a general work on the subject.

For information on the Reptiles and Fishes of West Africa we must refer to Aug. Duméril's memoir in the tenth volume of the "*Archives du Muséum et Histoire Naturelle*," founded on the collections in the Paris Museum.

## 2. SOUTH-WESTERN AFRICA.

The Portuguese colonies of Angola and Benguela, which seem to belong to a zoological sub-region, distinct from both that of West Africa and that of the Cape, were until recently almost unexplored. Within these last few years, however, Prof. Barboza du Bocage has acquired extensive series of specimens in nearly every department of natural history from these countries for the Lisbon Museum, and has published several important memoirs on the subject, which he will probably ultimately incorporate into a general work. Mr. J. J. Monteiro has also sent to this country collections of Mammals and Birds which have formed the subject of several papers in the Zoological Society's "*Proceedings*."

## 3. SOUTHERN AFRICA.

Sir Andrew Smith's "*Illustrations of the Zoology of South Africa*" constitute four solid octavo volumes, devoted to the new and rare vertebrates met with during that energetic traveller's many explorations of the Cape Colony and the

\* See Hume, "*Stray Feathers*," ii. p. 513 and iii. p. 215.

† Cf. P.Z.S. 1873, p. 647.

\* See notices, P.Z.S. 1839, 1842, and 1844.

adjoining districts. But there is no perfect list of the Cape fauna given in Sir Andrew Smith's work, and Mr. Layard's "Birds of South Africa," though not very completely elaborated, was, therefore, a most acceptable and convenient work to the ornithologist. Still more agreeable will it be to witness the completion of the new and enlarged edition of Mr. Layard's little volume, which Mr. Sharpe has undertaken, and of which he has just issued the first part. Mr. Sharpe will however, I trust, pardon me for remarking that he has cut the synonymy of the species rather short in his pages. It is hard to expect every South-African colonist to have at his side the British Museum Catalogue of Birds, to which he always refers us. Another modern and much-to-be-recommended bird-book belonging to this sub-region is Mr. J. H. Gurney's "Birds of Damara-land" founded on the extensive collection of the late C. J. Anderson. No less than 428 species of birds were obtained by this indefatigable collector, and the task of editing his field-notes has been well performed by Mr. Gurney.

#### 4. SOUTH-EASTERN AFRICA.

Our knowledge of the fauna of Mozambique is chiefly due to the scientific visit made to that country by Dr. W. Peters, of Berlin, in 1842 and the following years. The volume of this distinguished naturalist, "Naturwissenschaftliche Reise nach Mozambique," on the Mammals was published in 1852, that on the Fishes in 1864. The delay in the issue of the portions relating to the Reptiles and Birds is much to be regretted, more especially when we consider the high standard of the work, although diagnoses of the new species discovered in these groups have been long since published; and I am sure I am expressing the sentiments of naturalists in general when I say that I hope to see the series shortly completed. Proceeding further north along the African coast, we come to Zanzibar, where an excellent ichthyologist, Consul Playfair, was lately resident. The "Fishes of Zanzibar," by Günther and Playfair, founded on the extensive collections here made, was published in 1866, and gives an account of above 500 species, and many excellent figures.

The ornithology of the whole East-African coast, from Cape Gardafui to Mozambique, has been elaborately worked out by Drs. Finsch and Hartlaub. The results are contained in these authors' "Vogel Ost-Afrikans," forming the fourth volume of the unfortunate Baron Carl Claus von der Decken's "Reisen in Ost-Afrika." Full details as to older authorities on the subject are given in this excellent work, so that it is not necessary to refer to them.

As regards the Mammals of this part of Africa, however, it is necessary to say a few words. Our knowledge of this class of animals is, as regards the coast opposite Zanzibar and the country surrounding the great lakes of the interior, mainly comprised in the fragmentary collections of Speke and Grant (of which an account has been published in the Zoological Society's "Proceedings," and in the few specimens transmitted by Dr. Kirk from Zanzibar. There is no doubt, however, that much remains to be done here, and I believe there is at the present moment no finer field for zoological discovery available than this district, where we know that animal life in every variety is still abundant, and excellent sport can be obtained to add a zest to scientific investigation. The fishes of the great lake of Tanganyika and the Victoria and Albert Nyanza are likewise utterly unknown, and their investigation would be a subject of the greatest interest. Of those of the more southern Nyassa Lake, a few specimens have been obtained by Dr. Kirk.

#### 5. NORTH-EAST AFRICA.

For many years Rüppell's "Atlas" and "Neue Wirbelthiere," and, as regards birds, his "Systematische Uebersicht," remained our standard works of reference upon the zoology of North-eastern Africa. The recent completion of Th. von Heuglin's "Ornithologie Nordost-Afrikas" has superseded Rüppell's volumes for general use; and no more valuable piece of work for ornithologists has been accomplished of late years than the reduction of the multitudinous observations and records of this well-known traveller and naturalist into a uniform series. V. Heuglin's work, however, concerns mainly Upper Nubia, Abyssinia, and the wide territory drained by the confluent of the Upper Nile. For Egypt and the Lower Nile a more handy volume is Capt. Shelley's "Birds of Egypt," published in 1872, which will be found specially acceptable

to the tourist on the Nile. Nor must I forget to mention Mr. Blanford's interesting volume on the Geology and Zoology of Abyssinia, which contains an account of the specimens of Vertebrates collected and observed during his companionship with the Abyssinian Expedition. Mr. Jesse's birds, collected on the same occasion, were examined by Dr. Finsch, and the result given to the world in a memoir published in the Zoological Society's "Transactions."

A good revision of the Mammal-fauna of North-east Africa is much to be desired. Meanwhile Fitzinger's list of v. Heuglin's collection, and the latter author's own account of them in his Travels on the White Nile may be consulted.

#### 6. ARABIA.

Of Arabia, as might have been expected, we know but little, zoologically or otherwise. But little, it may be said, can be expected to be found there, looking to the general aspect of the country. Still it would be of interest to know what that little is. At present the only district that has been visited by naturalists is the peninsula of Sinai, and of this our knowledge is by no means complete. Hemprich and Ehrenberg's unfinished "Symbolæ Physicæ" was for many years our sole authority. More recently Mr. Wyatt has published an article in the "Ibis" upon the birds of the Sinaitic peninsula. Let me suggest to some of the officers who are stationed idle at Aden that an account of the animals to be met with in that part of Arabia would be of great value, and would give them much useful and interesting occupation. I have been more than once told that there is nothing whatever to be found there. But this I am slow to believe. Anyone with a good pair of eyes and a taste for collecting might certainly do much good to science by passing a few months at Aden, and making excursions into that part of "Arabia Felix."

#### IIa.—LEMURIAN SUB-REGION.

This aberrant appendage of the Ethiopian Fauna I will speak of under two heads, namely:—

1. Madagascar.
2. Mascarene Islands.

##### I. MADAGASCAR.

To our knowledge of the extraordinary fauna of "Lemuria," as I have elsewhere proposed to call Madagascar and its islands,\* great additions have been recently made, but it is manifest that Madagascar is by no means yet worked out.† Dr. Hartlaub's "Ornithologischer Beitrag zur Fauna Madagascars" was the first attempt at a *résumé* of the remarkable avifauna of this part of the world. Since its issue two Dutch naturalists, Pollen and Van Dam, have visited Madagascar, and forwarded rich collections to the Leyden Museum. Of these the Mammals and Birds have been worked out by Professor Schlegel and Mr. Pollen, and the results published in a well-illustrated volume entitled "Recherches sur la Faune de Madagascar." This has been since followed by an accompanying account of the Fishes, and treatise on the Fisheries, by Messrs. Bleeker and Pollen. Following upon the footsteps of these naturalists, a French explorer, Alfred Grandidier, has since visited the interior of Madagascar, and in his turn has reaped a grand harvest, of which some of the results have already been given to the public. But we are promised to have these discoveries in a much more extended and complete form, in a work now in progress, in which M. Grandidier has obtained the efficient assistance of M. Alphonse Milne-Edwards. There still remain to be spoken of the discoveries recently made by an English collector in Madagascar, Mr. A. Crossley. Mr. Crossley's birds have been worked out by Mr. Sharpe in several papers published from time to time by the Zoological Society, while Dr. Günther has described several new and remarkable Mammals from the same source.

##### 2. THE MASCARENE ISLANDS.

The fauna of the islands of Bourbon, Mauritius, and Rodriguez forms an appendage to that of Madagascar, and merits careful study. Our knowledge of these islands, since the recent investigation of Rodriguez by the naturalists sent out with the Venus Expedition, is tolerably complete, but requires to be put together, as it consists of fragments dispersed over various

\* Quart. Journ. of Science, 1864, p. 213.

† Witness the Mammal-forms, *Brachytaromys* and *Mixocebus*, lately described by Dr. Günther and Dr. Peters, and the new genus of birds, *Neodrepanis*, recently characterised by Mr. Sharpe.



journals and periodicals. I trust that Mr. Edward Newton, who has had so many opportunities of acquiring information on this subject during his Colonial Secretaryship at Mauritius, and has so well used these opportunities, may shortly have leisure to devote to this task. His labours to recover the skeleton of *Pezophaps*, in which, I am pleased to think, he was aided by a grant from this Association, are well known, as is likewise the excellent memoir by himself and Prof. Newton, in which the result of his labours was given to the world. Nor must I omit to mention Prof. Owen's dissertations on the extinct fellow-bird of Mauritius, recently published by the Zoological Society.

As regards the recent ornithology of these islands, we have nothing later to refer to than Hartlaub's little work on Madagascar, noticed above, which includes what was then known of the avifauna of the Mascarenes.

The neighbouring group of the Seychelles was visited by Mr. Edward Newton in 1867, and several new and most interesting species of birds obtained there. A complete account of the ornithology of these islands was given by Mr. Newton in the "Ibis" for 1867. Since that period Dr. E. P. Wright, formerly an active member of this Association, has made a scientific excursion to the Seychelles, with a view, as was generally understood, of preparing a complete monograph of the fauna and flora of these interesting islands. It is much to be regretted that this very desirable plan has not yet been accomplished.

### III.—INDIAN REGION.

Of the extensive and varied Indian Region I will now proceed to say something under the subjoined heads:—

1. *British India.*
2. *Central and Southern China.*
3. *Burmah, Siam, and Cochín.*
4. *Malay Peninsula.*
- 4a. *Andaman and Nicobar Islands.*
5. *East-Indian Islands.*
6. *Philippine Archipelago.*

#### I. BRITISH INDIA.

For British India Dr. Jerdon's well-known series of zoological handbooks was intended to supply a long-standing want; and it is a great misfortune that his untimely death has interfered with their completion. The three volumes on Birds were finished in 1866, and one on Mammals in 1867. Of the volume on the Reptiles and Batrachians a portion, I believe, was actually in type at the time of his decease; but of the Fishes no part, as far as I know, was so much advanced. For the Reptiles, therefore, we must for the present refer to Dr. Günther's "Reptiles of British India," published by the Ray Society in 1864. Indeed, as regards India, any future account of these animals must, in any case, be founded upon the basis of that excellent and conscientious work. For the Indian fishes generally there is at present no one authority, though Dr. Day, author of the "Fishes of Malabar" and of numerous other papers, is understood to have in preparation a general work on this subject, which his office of Inspector-General of Indian Fisheries has given him excellent opportunities of studying. Complete lists of both the freshwater and marine species of India are given in the appendices to Dr. Day's two "Reports on the Fisheries of India and Burmah," published in India in 1873.

But although our wants as regards the Indian Vertebrates will probably be supplied in this way, it would be much more satisfactory if the Indian Government would select a successor to Dr. Jerdon, and place under his control the necessary means for the preparation of a series of zoological handbooks for India. There is no reason why botany should be more favoured than zoology in this matter; and I believe it is only the greater energy of the botanist [that in this, as in other cases, has given them the start. New editions of Dr. Jerdon's Mammals and Birds are both necessary to bring our knowledge up to date, and the original editions are long out of print. There can be no question as to the great impetus to the study of natural history in India that has already followed on the publication of these handbooks; and it will be a great misfortune to science if our Indian rulers fail to continue the good work. They have only to select a competent editor for the series, and to place the necessary funds temporarily at his disposal. The sale of the works would in the end recoup all the necessary expenses.

Amongst more recent contributions to our knowledge of Indian ornithology, which, under the influence above referred to, have been especially numerous, I can now only stop to call

attention to a few. Mr. Allan Hume, C.B., has been specially active, and has published numerous papers in his queerly-titled periodical "Stray Feathers," which is exclusively devoted to Indian Ornithology. Amongst them the articles on the birds of Scinde and those of Upper Pegu are of special interest. Mr. Holdsworth's most useful "Synopsis of the Birds of Ceylon," lately published in the "Proceedings of the Zoological Society," is also of great value, more especially as Ceylon was omitted from the scope of Dr. Jerdon's work. Nor must I omit to mention Major Godwin-Austen's series of papers on the ornithology of the newly-explored districts on the north-eastern frontier, which contains so much of novelty and instruction.

As regards the Testudinata of India, we may shortly expect a complete account of them from Dr. John Anderson, who has devoted much time and toil to their study. His magnificent series of drawings of these animals, from living specimens, I have had the pleasure of inspecting; and I trust sincerely that some means may be found of reproducing them for publication. Such a work would vastly increase our knowledge of this very difficult group of animals.

#### 2. CENTRAL AND SOUTHERN CHINA.

In speaking of Northern China I have introduced the names of the two great modern zoological discoverers in China, Mr. Robert Swinhoe and M. le Père David. Mr. Swinhoe's article on the "Mammals of China," recently published in the Zoological Society's "Proceedings" gives a complete list of the species known to him to occur south of the Yang-tze. It includes those of the great island of Formosa, which is essentially part of China, although it possesses some endemic species, and which was a complete *terra incognita* to naturalists before Mr. Swinhoe's happy selection as the first British Vice-Consul in 1861. Mr. Swinhoe's last revised catalogue of the Birds of China, published in 1871, has been already referred to. He is now at home, unfortunately in ill health, but is by no means idle on his bed of sickness, and has in contemplation, and, I may say, in actual preparation, a complete work on Chinese Ornithology, for which he has secured the co-operation of one of our most competent naturalists.

The still more remarkable discoveries of Père David have revealed to us the existence on the western outskirts of China, or on the border-lands between China and Tibet, of a fauna hitherto quite unknown to us, and apparently a pendant of the Sub-Himalayan Hill-fauna first investigated by Hodgson. In his recently completed "*Recherches sur les Mammifères*," already referred to, M. Alphonse Milne-Edwards has given us a complete account of M. David's wonderful discoveries among the Mammals of this district. M. David's birds were worked out by the late Jules Verreaux, and the novelties described in the "*Nouvelle Archives*," but no complete list of them has yet been issued. In herpetology, I believe, M. David has also made some remarkable discoveries, amongst which, not the least assuredly, is the discovery of a second species of gigantic Salamander\* in the mountain-streams of Moupin.

#### 3. BURMAH, SIAM, AND COCHIN.

I speak of these ancient kingdoms, which occupy the main part of the great peninsula of South-eastern Asia, principally to express my surprise at how little we yet know of them. There are several good correspondents of the *Jardin des Plantes* in the French colony of Saigou, who have, I believe, transmitted a considerable number of specimens to the *Muséum d'Histoire Naturelle*, but beyond the descriptions of a certain number of novelties we have as yet received no account of them. The two philosophic Kings of Siam appear not yet to have turned their attention to biological discovery, although there is certainly much to be done in the interior of that State, with which the late M. Mouhot, had his life been spared, would certainly have made us better acquainted. As it happens we have only one or two published memoirs upon the results which this unfortunate naturalist achieved.

Lower Burmah now forms part of British India, and will be doubtless well explored. As regards Burmah proper and the Shan-States, our Indian legislators appointed a most efficient naturalist to accompany the Yucan Expedition of 1868; but when he returned, refused or neglected to provide him with the facilities to work out and publish his results. I rejoice, however, to learn that this error has been to a certain extent remedied,

\* *Sieboldia Davidiana*, Blanchard.

and that Dr. Anderson has now in preparation a connected account of his Yucan discoveries, which is to be issued by the Linnean Society in their "Transactions." A separate publication of these results would not have involved much additional expense, and would have been more worthy of the Government which sent out the expedition.

#### 4. MALAY PENINSULA.

The Malay peninsula belongs unquestionably to the same Sub-fauna as Sumatra. Its zoology is tolerably well known to us from numerous collections that have reached this country, but a modern revision of all the classes of Vertebrates is much to be desired. About twenty years ago, Dr. Cantor, of the East Indian Medical Service, published catalogues of the Mammals, Reptiles, and Fishes of Malacca in the *Journal of the Asiatic Society of Bengal*. To obtain a knowledge of its birds we must refer to the papers of Eyton, Wallace, and various other ornithological writers.

#### 4a. ANDAMAN AND NICOBAR ISLANDS.

The two groups of islands in the Bay of Bengal have of late years attracted considerable attention from naturalists. Port Blair, in the Andaman Islands, having become the seat of an Indian penal settlement, has received visits from several excellent Indian workers who have made extensive collections, especially in ornithology. The most recent authorities upon the birds of the Andaman Islands are Lord Walden, who has worked out the series forwarded to him by Lieut. Wardlaw Ramsay, and Mr. Vincent Ball, who has published in "Stray Feathers" a complete list of all the birds known to occur in the Andaman and Nicobar groups.

#### 5. EAST INDIAN ISLANDS.

Up to a recent period the standard authority on the fauna of the East Indian Islands was the great Dutch work on the Zoology of the foreign possessions of the Netherlands Government, based upon the vast collections formed by Macklot, Müller, and other naturalists, and transmitted to the Leyden Museum. This has been supplemented of late years by several works and memoirs of Dr. Schlegel, the eminent director of that establishment, and in particular by his "*Musée des Pays Bas*," which contains an account of that magnificent collection drawn up in a series of monographic catalogues. Up to this time, however, Dr. Schlegel has only treated of the class of birds, though at the present moment, I believe, he is engaged on a revision of *Quadrupana*. To the class of fishes, and especially to the fishes of the Dutch Islands and Seas in the East Indies, another naturalist, Dr. P. P. Bleeker, has for many years devoted great attention. His memoirs and papers on the Ichthyology and Herpetology of the various islands and settlements are far too numerous to mention. But his "*Atlas Ichthyologique*," his principal work on the Fishes of the Indian Seas, is one of great importance, and claims a special record as embracing the results of the life-work of one of the most energetic and laborious of living naturalists.

The travels of our countryman, Mr. Wallace, in the Malay Archipelago are well known to the general public from his instructive and entertaining narrative, and to zoologists from the large collections which he made in every branch of natural history. It is a misfortune that no general account of them has ever been prepared. But special articles on the birds of the Sula group to the east of Celebes or those of Bourou, and on those of the islands of Timor, Flores, and Lombok, will be found in the Zoological Society's "Proceedings," besides other ornithological papers referring more or less to this district.

Of the island of Celebes we have acquired more intimate knowledge from the researches of Dr. A. B. Meyer, and from two excellent memoirs on its Ornithology, prepared by Lord Walden. The adjacent territory of Borneo has likewise not escaped the attention of recent writers, an accomplished Italian author, Dr. Salvadori, having made it the subject of a special ornithological essay. For the animals of Java and Sumatra, we have unfortunately no such recent authority, but must refer primarily in the one case to Horsfield's Zoological Researches, and in the other to Sir Stamford Raffles' Catalogue, supplementing in each case the deficiency by reference to various more recent books and memoirs. The fact is that before we can attain precise notions as to the real zoological relations of these great islands, we require a much more complete acquaintance with their different faunas, and special monographic essays upon them. So

there is certainly no lack of work remaining for the zoologist in this quarter.

#### 6. PHILIPPINE ARCHIPELAGO.

In spite of the visits of Cuming, and more recently of Semper and Jagor, there has been until very lately great lack of a work for reference on the Vertebrates of the Philippine Archipelago. This deficiency has been partly supplied by the excellent essay published by Lord Walden in the "*Transactions*," of the Zoological Society, upon the Birds of the Philippines. Although based upon the collections of Dr. A. B. Meyer, this memoir contains a *résumé* of all that is yet known upon the subject. It likewise points out the deficiencies in our present information, which, I need hardly add, are many and numerous.

That the knowledge of our Mammal-fauna of the Philippines is also by no means perfect, will be sufficiently manifest when I recall to my hearers the fact that there is now living in the Zoological Society's Gardens a very distinct species of Deer, \* quite unknown to all our Museums, which is undoubtedly endemic in one of the Philippine Islands. There is much want of more information on this subject, as also on the Reptiles and Fishes, although Dr. Peters has lately made us acquainted with many novelties from Jagor's researches in these branches.

#### IV.—NEARCTIC REGION.

This part of my subject will be most conveniently treated of under two heads:—

1. *North America down to Mexico,*
2. *Greenland,*

leaving Mexico to be spoken of as a whole under the Neotropical Region, although part of it undoubtedly belongs to the Nearctic.

##### I. NORTH AMERICA.

(a.) *Mammals*.—The latest revision of the Mammals of North America is still that of Prof. Baird, contained in the Reports on the Zoology of the Pacific Railway Routes, published by the War Department of the U.S. in 1857. I understand, however, that Dr. Coues is now engaged on a more perfect work on the same subject, which will embrace the results of the large additions since made to our knowledge of this subject. The marine Mammals are not included in Prof. Baird's revision; and under this head I may notice two important works recently issued, Mr. Allen's memoir on the Eared Seals, which specially treats of the North-Pacific species, and Capt. Scammon's volume on the marine Mammals of the North-western coasts of North America, which contains a mass of information relative to the little-known Cetaceans of the North Pacific.

Prior to them Audubon and Bachman's *Quadrupeds of North America*, published at New York in 1852, was the best book of reference.

(b.) *Birds of North America*.—The American ornithologists have been specially active of late years. Up to about twenty years ago, the recognised authorities upon the Birds of the United States were Wilson, Audubon, Bonaparte, and Nuttall. In 1856 Cassin's "*Illustrations*," chiefly devoted to the species then recently discovered in Texas, California, and Oregon, appeared. In 1858 the joint work of Messrs. Baird, Cassin, and Lawrence, on the Birds of North America, forming part of the "*Pacific Railway Routes*," was issued. This was republished with additions as a separate work in 1860 in two volumes, and still forms an excellent work of reference on American ornithology. The List of Authorities given at the end of the letterpress will be found extremely useful for those who require a guide to the literature of American ornithology. But even this bids fair to be superseded by the more recent publications of our energetic fellow naturalists. In the first place, three volumes of a "*History of North-American Birds*," illustrated by plates and numerous woodcuts, by Messrs. Baird, Brewer, and Ridgway (were issued last year, and two more volumes to complete the work will soon be ready. Then for those who require a handy book for reference nothing can be more convenient than Dr. Coues' "*Key*," in one volume, published in 1872. The same energetic naturalist has also lately issued a "*Handbook of the Ornithology of the North-west*," containing an account of the birds met with in the region drained by the Missouri and its tributaries, amongst which he has had such long personal experience. Nor must I conclude the list without mentioning Mr. D. G. Elliot's "*Birds of North America*," which contains life-sized illustrations of many rare

*Cervus Alfredei*, Sclater, P.Z.S. 1870, p. 381, pl. xxviii.



and previously unfigured species, and Cooper's "Birds of California," devoted to an account of the birds of the Pacific coast-region, which has been edited by Prof. Baird from the late Mr. Cooper's MSS. Of the last-named work, however, only the first volume is yet published. It will be thus seen that we have ample means of acquiring the most recent information on the birds of the Nearctic Region, and in fact in no part of the world, except Europe itself, is our knowledge of the endemic avifauna so nearly approaching towards completion.

(c.) *Reptiles and Batrachians of North America*.—Holbrook's "North American," in five quarto volumes, published at Philadelphia in 1843-4, contains coloured figures of all the North American Reptiles and Batrachians known to the author, and is a reliable work. A large amount of information has been acquired since that period and published in the various "Railway Reports" and periodicals by Hallowell, Baird, Cope, and others. In 1853 Messrs. Baird and Girard published a catalogue of North American Serpents, and Prof. Agassiz devoted the first volume of his "Contributions" mainly to the Testudinata of North America. Prof. Baird tells me that Prof. Cope is now engaged in printing a new catalogue of the Reptiles and Batrachians of North America, which will contain an enumeration of all the species and an account of their geographical distribution.

(d.) *Fishes of North America*.—Of the fishes of North America there is up to the present time no one authority, and the inquirer must refer to the various works of De Kay, Agassiz, and Girard for information. This, aided by the copious references in Dr. Günther's masterly Catalogue, he will have little difficulty in obtaining, so far as it is available. But the "History of American Fishes" is still to be written, and I have no doubt that our energetic brethren of the United States will before long bring it to pass.

## 2. GREENLAND.

Of Greenland, which is undoubtedly part of the Nearctic Region, I have made a separate section in order to call special attention to the "Manual" for the use of the Arctic Expedition of 1875, prepared under the direction of the Arctic Committee of the Royal Society. A *résumé* of all that is yet known of the biology of Greenland is included in this volume. I may call special attention to the article on the Birds by Prof. Newton, and on the Fishes by Dr. Lütken, both prepared specially for this work. I am sure you will all join with me in thanking the present Government for sending out this new expedition so fully prepared in every way, and in hoping that large additions may be made to the store of information already accumulated in the "Manual."

(To be continued.)

### Department of Anthropology.

ADDRESS BY GEORGE ROLLESTON, M.D., F.R.S., F.S.A.,  
PRESIDENT OF THE DEPARTMENT.

Dr. Rolleston began his address by referring to a few of the principal papers which were to be brought before the department. He referred in congratulatory terms to the work in the Pacific Islands brought out this year by Dr. Carl E. Meinicke, and to an article by the Rev. S. J. Whitmee in the *Contemporary Review* for February as the most important recent contribution to the ethnology of Polynesia. He then spoke in high terms of the services rendered to the native Polynesians by the missionaries, quoting to the same effect from Gerland's continuation of Wurtz's "Anthropologie." He also referred critically to Mr. Bagehot's statement that savages did not formerly waste away before the classical nations, as they do now before the modern civilised nations. He then went on to say:—

I come now to the consideration of the subject of craniology and craniography. Of the value of the entirety of the physical history of a race there is no question; but two very widely opposed views exist as to the value of skull-measuring to the ethnographer. According to the views of one school, craniography and ethnography are all but convertible terms; another set of teachers insist upon the great width of the limits within which normal human crania from one and the same race may oscillate, and upon the small value which, under such circumstances, we can attach to differences expressed in tenths of inches or even of centimetres. As usual, the truth will not be found to be in either extreme view. For the proper performance of a craniographic estimation, two very different processes are necessary: one is the carrying out and recording a number of

measurements; the other is the artistic appreciation of the general impressions as to contour and type which the survey of a series of skulls produce upon one. I have often thought that the work of conducting an examination for a scholarship or fellowship is very similarly dependent, when it is properly carried out, upon the employment of two methods—one being the system of marking, the other that of getting a general impression as to the power of the several candidates; and I would wish to be understood to mean by this illustration not only that the two lines of inquiry are both dependent upon the combination and counter-checking of two different methods, but also that their results, like the results of some other human investigations, must not be always, even though they may be sometimes, considered to be free from all and any need for qualification. Persons like M. Broca and Prof. Aeby, who have carried out the most extensive series of measurements, are not the persons who express themselves in the strongest language as to craniography being the universal solvent in ethnography or anthropology. Aeby, for example, in his "Schädelformen der Menschen und der Affen," 1867, p. 61, says:—"Aus dem gesagten geht hervor dass die Stellung der Anthropologie gegenüber den Schädelformen eine ausserordentlich schwierige ist;" and the perpetual contradiction of the results of the skull-measurements carried out by others, which his paper (published in last year's "Archiv für Anthropologie," pp. 12, 14, 20) abounds in, furnishes a practical commentary upon the just quoted words. And Broca's words are especially worth quoting, from the "Bulletin de la Société d'Anthropologie de Paris," Nov. 6, 1873, p. 824:—"Dans l'état actuel de nos connaissances la craniologie ne peut avoir la prétention de voler de ses propres ailes, et de substituer ses diagnostics aux notions fournies par l'ethnologie et par l'archéologie."

I would venture to say that the way in which a person with the command of a considerable number of skulls procured from some one district in modern times, or from some one kind of tumulus or sepulchre in prehistoric times, would naturally address himself to the work of arranging them in a museum, furnishes us with a concrete illustration of the true limits of craniography. I say, "a person with the command of a considerable number of skulls;" for, valuable as a single skull may be, and often is, as furnishing the missing link in a gradational series, one or two skulls by themselves do not justify us (except in rare instances, which I will hereinafter specify) in predicating anything as to their nationality. Greater rashness has never been shown, even in a realm of science from which rashness has only recently been proceeded against under an Alien Act, than in certain speculations as to the immigration of races into various corners of the world, based upon the casual discovery in such places of single skulls, which skulls were identified on the ground of their individual characters as having belonged to races shown on no other evidence to have ever set foot there.

It is, of course, possible enough for a skilled craniographer to be right in referring even a single skull to some particular nationality; an Australian or an Eskimo, or an Andamanese might be so referred with some confidence; but all such successes should be recorded with the reservation suggested by the words, *ubi eorum qui perierunt?* and by the English line, "The many fail, the one succeeds." They are the shots which have hit and have been recorded. But if it is unsafe to base any ethnographic conclusions upon the examination of one or two skulls, it is not so when we can examine about ten times as many—ten, that is to say, or twenty, the locality and the dates of which are known as certain quantities. A craniographer thus fortunate casts his eye over the entire series, and selects from it one or more which correspond to one of the great types based by Retzius not merely upon consideration of proportionate lengths and breadths, but also upon the artistic considerations of type, curve, and contour. He measures the skulls thus selected, and so furnishes himself with a check which even the most practised eye cannot safely dispense with. He then proceeds to satisfy himself as to whether the entire series is referable to one alone of the two great typical forms of Brachycephaly or Dolichocephaly, or whether both types are represented in it, and if so, in what proportions and with what admixture of intermediate forms. With a number of Peruvian, or, indeed, of Western American skulls generally, of Australian, of Tasmanian, of Eskimo, of Veddah, of Andamanese crania before him, the craniographer would nearly always, setting aside a few abnormally aberrant (which are frequently morbid) specimens, refer them all to one single type.\*

\* It is not by any means entirely correct to say that there is no variety observable among races living in isolated savage unity. The good people of

Matters would be very different when the craniographer came to deal with a mixed race like our own, or like the population of Switzerland, the investigation into the craniology of which has resulted in the production of the invaluable "*Crania Helvetica*" of His and Rütimeyer. At once, upon the first inspection of a series of crania, or, indeed, of heads, from such a race, it is evident some are referable to one, some to another, of one, two, or three typical forms, and that a residue remains whose existence and character is perhaps explained and expressed by calling them "*Mischformen*." Then arises a most interesting question—Has the result of intercrossing been such as to give a preponderance to these "*Mischformen*?" or has it not rather been such as in the ultimate resort, whilst still testified to by the presence of intermediating and interconnecting links, to have left the originally distinct forms still in something like their original independence, and in the possession of an overwhelmed numerical representation? The latter of these two alternative possibilities is certainly often to be seen realised within the limits of a modern so-called "English" or so-called "British" family; and His has laid this down as being the result of the investigations above mentioned into the ethnology of Switzerland. At the same time it is of cardinal importance to note that His has recorded, though only in a footnote, that the skulls which combine the characters of his two best-defined types, the "*Sion-Typus*" to wit, and the "*Disentis-Typus*," in the "*Mischform*," which he calls "*Sion-Disentis Mischlinge*," are the most capacious of the entire series of the "*Crania Helvetica*," exceeding, not by their maximum only, but by their average capacity also, the corresponding capacities of every one of the pure Swiss types.\* Intercrossing, therefore, is an agency which in one set of cases may operate in the way of enhancing individual evolution, whilst in another it so divides its influence as to allow of the maintenance of two types in their distinctness. Both these results are of equal biological, the latter is of pre-eminent archæological, interest. Retzius† was of opinion, and with a few qualifications I think more recent Swedish ethnologists would agree, that the modern dolichocephalic Swedish cranium was very closely allied to, if not an exact reproduction of the Swedish cranium of the Stone period; and Virchow‡ holds that the modern brachycephalic Danish skull is similarly related to the Danish skull of the same period. There can be no doubt that the Swedish cranium is very closely similar indeed to the Anglo-Saxon; and the skulls which still conform to that type amongst us will be by most men supposed to be the legitimate representatives of the followers of Hengest and Horsa, just as the modern Swedes, whose country has been less subjected to disturbing agencies, must be held to be the lineal descendants of the original occupiers of their soil. I am inclined to think that the permanence of the brachycephalic stock and type in Denmark has also its bearing upon the ethnography of this country. In the Round-Barrow or Bronze period in this country, sub-spheroidal crania (that is to say, crania of a totally different shape and type from those which are found in exclusive possession of the older and longer barrows) are found in great abundance, sometimes, as in the south, in exclusive possession of the sepulchre, sometimes in company, as in the north, with skulls of the older type. The skulls are often strikingly like those of the same type from the Danish tumuli. On this coincidence I should not stake much, were it not confirmed by other indications. And foremost amongst these indications I should place the fact of the "*Tree-interments*," as they have been called—interments, that is, in coffins made out of the trunk of a tree of this country, and of Denmark, being so closely alike. The well-known monoxylic coffin from Gristhorpe contained, together with other relics closely similar to the relics found at Treenhoi, in South Jutland, in a similar coffin, a skull which, as I can testify from a cast given me by my friend Mr. H. S. Harland, might very well pass for that of a brachycephalic Dane of the Neolithic period. Canon Greenwell discovered a similar

monoxylic coffin at Skipton, in Yorkshire; and two others have been recorded from the same county, one from the neighbourhood of Driffield, the other from that of Thornborough.

Col. Lane Fox is of opinion that the earthworks which form such striking objects for inquiry here and there on the East Riding Wolds must, considering that the art of war has been the same in its broad features in all ages, have been thrown up by an invading force advancing from the east coast. Now, we do know that England was not only made England by immigration from that corner or angle where the Cimbric Peninsula joins the main land, but that long after that change of her name this country was successfully invaded from that peninsula itself. And what Swegen and Cnut did some four hundred and fifty years after the time of Hengest and Horsa, it is not unreasonable to suppose other warriors and other tribes from the same locality may have done perhaps twice or thrice as many centuries further back in time than the Saxon Conquest. The huge proportions of the Cimbri, Teutones, and Ambrones, are just what the skeletons of the British Round-Barrow folk enable us now to reproduce for ourselves. It is much to be regretted that from the vast slaughters of Aquæ Sextiæ and Vercellæ no relics have been preserved which might have enabled us to say whether Boiorix and his companions had the cephalic proportions of Neolithic Danes, or those very different contours which we are familiar with from Saxon graves throughout England, and from the so-called "*Danes' graves*" of Yorkshire. Whatever might be the result of such a discovery and such a comparison, I think it would in neither event justify the application of the term "*Kymric*" to the particular form of skull to which Retzius and Broca have assigned it.

Some years ago I noticed the absence of the brachycephalic British type of skull from an extensive series of Romano-British skulls which had come into my hands; and subsequently to my doing this, Canon Greenwell pointed out to me that such skulls as we had from late Celtic cemeteries, belonging to the comparatively short period which elapsed between the end of the Bronze period and the establishment of Roman rule in Great Britain, seemed to have reverted mostly to the præ-Bronze dolichocephalic type. This latter type, the "*kumbecephalic type*" of Prof. Daniel Wilson, manifests a singular vitality, as the late and much lamented Prof. Phillips pointed out long ago at a meeting of this Association held at Swansea—the dark-haired variety, which is very ordinarily the longer-headed and the shorter-statured variety of our countrymen being represented in very great abundance in those regions of England which can be shown, by irrefragable and multifold evidence, to have been most thoroughly permeated, imbibed, and metamorphosed by the infusion of Saxons and Danes in the districts, to wit, of Derby, Leicester, Stamford, and Loughborough. How and in what way this type of man, one to which some of the most valuable men now bearing the name of Englishmen, which they once abhorred, belong, has contrived to reassert itself, we may, if I am rightly informed, hear some discussion in this department. Before leaving this part of my subject I would say that the Danish type of head still survives amongst us; but it is to my thinking not by any means so common, at least in the mid-land counties, as the dark-haired type of which we have just been speaking. And I would add that I hope I may find that the views which I have here hinted at will be found to be in accord with the extensive researches of Dr. Beddoe, a gentleman who worthily represents and upholds the interests of anthropology in this city, the city of Prichard, and who is considered to be more or less disqualified for occupying the post which I now hold, mainly from the fact that he has occupied it before, and that the rules of the British Association, like the laws of England, have more or less of an abhorrence of perpetuities.

The largest result which craniometry and cubage of skulls have attained is, to my thinking, the demonstration of the following facts, viz.:—first, that the cubical contents of many skulls from the earliest sepulchres from which we have any skulls at all, are larger considerably than the average cubical contents of modern European skulls; and secondly, that the female skulls of those times did not contrast to that disadvantage with the skulls of their male contemporaries which the average female skulls of modern days do, when subjected to a similar comparison.\* Dr. Thurnam demonstrated the former of these facts, as regards the skulls from the Long and the Round Barrows of

Baden who, when they first saw them, said all the Baskhirs in a regiment brought up to the Rhine in 1813 by the Russians were as like to each other as twins, found, in the course of a few weeks, that they could distinguish them readily and sharply enough (*Crania Germaniæ Occid.* p. 2: *Archiv für Anthropol.* v. p. 485, 1872). And real naturalists, such as Mr. Bates, practised in the discrimination of zoological differences, express themselves as struck rather with the amount of unlikeness than with that of likeness which prevails amongst savage tribes of the greatest simplicity of life and the most entire freedom from crossing with other races. But these observations relate to the *living heads*, not to the skulls.

\* See Dr. Beddoe, *Mem. Soc. Anth. Lond.* iii. p. 552; Huth, p. 308, 1875; D. Wilson, cit. Brace, "*Races of the Old World*," p. 380.

† *Ethnologische Schriften*, p. 7.

‡ *Archiv für Anthropologie*, iv. pp. 71 and 80.

\* The subequality of the male and female skulls in the less civilised of modern races was pointed out as long ago as 1845 by Retzius, in Müller's "*Archiv*," p. 89, and was commented upon by Huschke, of Jena, in his "*Schädel, Hirn, und Seele*," pp. 48-51, in 1854.



Wiltshire, in the Memoirs of the London Anthropological Society for 1865; and the names of Les Eyzies and Cro-Magnon, and of the Caverne de l'Homme Mort, to which we may add that of Solutré, remind us that the first of these facts has been confirmed, and the second both indicated and abundantly commented upon by M. Broca.

The impression which these facts make upon one, when one first comes to realise them, is closely similar to that which is made by the first realisation to the mind of the existence of a subtropical flora in Greenland in Miocene times. All our anticipations are precisely reversed, and in each case by a weight of demonstration equivalent to such a work; there is no possibility in either case of any mistake; and we acknowledge that all that we had expected is absent, and that where we had looked for poverty and pinching there we come upon luxurious and exuberant growth. The comparisons we draw in either case between the past and the present are not wholly to the advantage of the latter: still such are the facts. Philologists will thank me for reminding them of Mr. Chauncy Wright's brilliant suggestions that the large relative size of brain to body which distinguishes, and always, so far as we know, has distinguished the human species as compared with the species most nearly related to it, may be explained by the psychological tenet that the smallest proficiency in the faculty of language may "require more brain power than the greatest in any other direction," and that "we do not know and have no means of knowing what is the quantity of intellectual power as measured by brains which even the simplest use of language requires."

And for the explanation of the pre-eminently large size of the brains of these particular representatives of our species, the tenants of prehistoric sepulchres, we have to bear in mind, first, that they were, as the smallness of their numbers and the largeness of the tumuli lodging them may be taken to prove, the chiefs of their tribes; and, secondly, that modern savages have been known, and prehistoric savages may therefore be supposed, to have occasionally elected their chiefs to their chieftainships upon grounds furnished by their superior fitness for such posts—that is to say, for their superior energy and ability. Some persons may find it difficult to believe this, though such facts are deposited to by most thoroughly trustworthy travellers, such as Baron Osten Sacken, referred to by Von Baer, in the Report of the famous Anthropological Congress at Göttingen, in 1861, p. 22. And they may object to accepting it, for, among other reasons, this reason—to wit, that Mr. Galton has shown us in his "Men of Science, their Nature and Nurture," p. 98, that men of great energy and activity (that is to say just the very men fitted to act as leaders of and to commend themselves to savages)† have ordinarily smaller-sized heads than men possessed of intellectual power dissociated from those qualities.

The objection I specify, as well as those which I allude to, may have too much weight assigned to them; but we can waive this discussion and put our feet on firm ground when we say that in all savage communities the chiefs have a larger share of food and other comforts, such as there are in savage life, and have consequently better and larger frames—or, as the Rev. S. Whitmee puts it (*l.c.*), when observing on the fact as noticed by him in Polynesia, a more "portly bearing." This (which, as the size of the brain increases within certain proportions with the increase of the size of the body, is a material fact in every sense) has been testified to by a multitude of other observers, and is, to my mind, one of the most distinctive marks of savagery as opposed to civilisation. It is only in times of civilisation that men of the puny stature of Ulysses or Agesilaus are allowed their proper place in the management of affairs. And men of such physical size, coupled with such mental calibre, may take comfort, if they need it, from the purely quantitative consideration, that large as are the individual skulls from prehistoric graves, and high, too, as is the average obtained from a number of them, it has nevertheless not been shown that the largest individual skulls of those days were larger than, or, indeed, as large as the best skulls of our own days; whilst the high average capacity which the former series shows is readily explicable by the very obvious consideration that the poorer specimens of humanity, if allowed to live at all in those days, were, at any rate, when dead not allowed sepulture in the "tombs of the

kings," from which nearly exclusively we obtain our prehistoric crania. M. Broca\* has given us yet further ground for retaining our self-complacency by showing, from his extensive series of measurements of the crania from successive epochs in Parisian burial-places, that the average capacity has gone on steadily increasing.

It may be suggested that a large brain, as calculated by the cubage of the skull, may nevertheless have been a comparatively lowly organised one, from having its molecular constitution qualitatively inferior from the neuroglia being developed to the disadvantage of the neurine, or from having its convolutions few and simple, and being thus poorer in the aggregate mass of its grey ossicular matter. It is perhaps impossible to dispose absolutely of either of these suggestions. But, as regards the first, it seems to me to be exceedingly improbable that such could have been the case. For in cases where an overgrowth of neuroglia has given the brain increase of bulk without giving it increase of its true nervous elements, the Scotch proverb, "Muckle brain, mickle wit," applies; and the relatively inferior intelligence of the owners of such brains as seen nowadays may, on the principle of continuity, be supposed to have attached to the owners of such brains in former times. But those times were times of a severer struggle for existence than even the present; and inferior intelligences, and specially the inferior quickness and readiness observable in such cases, it may well be supposed, would have fared worse than now. There is, however, no need for this supposition, for, as a matter of fact, the brain-case of brains so hypertrophied† has a very recognisable shape of its own, and this shape is not the shape of the Cro-Magnon skull, nor indeed of any of the prehistoric skulls with which I am acquainted.

As regards the second suggestion to the effect that a large braincase may have contained a brain the convolutions of which were simple, broad, and coarse, and which made up by consequence a sheet of grey matter of less square area than that made up in a brain of similar size, but of more complex and slenderer convolutions, I have to say that it is possible this may have been the case, but that it seems to me by no means likely. Very large skulls are sometimes found amongst collections purporting to have come from very savage or degraded races; such a skull may be seen in the London College of Surgeons with a label, "5357 D. Bushman, G. Williams. Presented by Sir John Lubbock;" and, from what Prof. Marshall and Gratiolet have taught us as to other Bushman brains, smaller, it is true, in size, we may be inclined to think that the brain which this large skull once contained may nevertheless have been much simpler in its convolutions than a European brain of similar size would be. This skull, however, is an isolated instance of such proportions amongst Bushman skulls, so far, at least, as I have been able to discover; whilst the skulls of prehistoric times, though not invariably, are yet most ordinarily large skulls. A large brain with coarse convolutions puts its possessor at a disadvantage in the struggle for existence, as its greater size is not compensated by greater dynamical activity; and hence I should be slow to explain the large size of ancient skulls by suggesting that they contained brains of this negative character. And I am glad to see that M. Broca is emphatically of this opinion, and that, after a judicious statement of the whole case, he expresses himself thus (*Revue d'Anthropologie*, ii. 1, 38):—"Rien ne permet donc de supposer que les rapports de la masse encéphalique avec l'intelligence fussent autres chez eux que chez nous."

It is by a reference to the greater severity of the struggle for existence and to the lesser degree to which the principle of division of labour was carried out in olden days, that M. Broca, in his paper on the "Caverne de l'Homme Mort," just quoted from, explains the fact of the subequality of the skulls in the two sexes. This is an adequate explanation of the facts; but to the facts as already stated, I can add from my own experience the fact that though the female skulls of prehistoric times are often they are not always equal, or nearly, to those of the male sex of those times; and, secondly, that whatever the relative size of the head, the limbs and trunk of the female portion of those tribes were, as is still the case with modern savages, very usually disproportionately smaller than those of the male. This is

\* The bibliographer will thank me also for pointing out to him that the important paper in the *North American Review* for October 1870, p. 295, from which I have just quoted, has actually escaped the wonderfully exhaustive research of Dr. Seidlitz (see his "Darwin'sche Theorie," 1875).

† An interesting and instructive story in illustration of the kind of qualities which do recommend a man to savages, is told us by Sir Bartle Frere his pamphlet, "Christianity suited to all forms of Civilisation," pp. 12-14.

\* See his paper "Bull. Soc. Anthropol. de Paris," t. iii. ser. i. 1862, p. 102; or his collected "Mémoires," vol. i. p. 348, 1871.

† I may, perhaps, be allowed to express here my surprise at the statement made by Messrs. Wilks and Moxon, in their very valuable "Pathological Anatomy," pp. 217, 218, to the effect that they have not met with such cases of cerebral hypertrophy. They were common enough at the Children's Hospital in Great Ormond Street when I was attached to it.

readily enough explicable by a reference to the operations of causes exemplifications of the working of which are unhappily not far to seek now, and may be found in any detail you please in those anthropologically interesting (however otherwise unpleasant) documents, the Police Reports.

Having before my mind the liability we are all under fallaciously to content ourselves with recording the shots which hit, I must not omit to say that one at least of the more recently propounded doctrines in craniology does not seem to me to be firmly established. This is the doctrine of "occipital dolichocephaly" being a characteristic of the lower races of modern days and of prehistoric races as compared with modern civilised races. I have not been able to convince myself by my own measurements of the tenability of this position; and I observe that Ihering has expressed himself to the same effect, appending his measurements in proof of his statements in his paper, "Zur Reform der Craniometrie," published in the "Zeitschrift für Ethnologie" for 1873. The careful and colossal measurements of Acby\* and Weisbach† have shown that the occipital region enjoys wider limits of oscillation than either of the other divisions of the cranial vault. I have some regret in saying this, partly because writers on such subjects as "Literature and Dogma" have already made use of the phrase "occipitally dolichocephalic," as if it represented one of the permanent acquisitions of science; and I say it with even more regret, as it concerns the deservedly honoured names of Gratiolet and of Broca, to whom anthropology owes so much. What is true in the doctrine relates, among other things, to what is matter of common observation as to the fore part of the head rather than to anything which is really constant in the back part of the skull. This matter of common observation is to the effect that when the ear is "well forward" in the head we do ill to augur well of the intelligence of its owner. Now, the fore part of the brain is irrigated by the carotid arteries, which, though smaller in calibre during the first years of life, during which the brain so nearly attains its full size, than they are in the adult, are nevertheless relatively large even in those early days, and are both absolutely, and relatively to the brain which they have to nourish, much larger than the vertebral arteries, which feed its posterior lobes. It is easy therefore to see that a brain in which the fore part supplied by the carotids has been stinted of due supplies of food, or however stinted in growth, is a brain the entire length and breadth of which is likely to be ill-nourished. As I have never seen reason to believe in any cerebral localisation which was not explicable by a reference to vascular irrigation, it was with much pleasure that I read the remarks of Messrs. Wilks and Moxon in their recently published "Pathological Anatomy," pp. 207, 208, as to the indications furnished by the distribution of the Tacchionian bodies as to differences existing in the blood-currents on the back and those on the fore part of the brain. These remarks are the more valuable, as mere hydraulics, Professor Clifton assures me, would not have so clearly pointed out what the physiological upgrowths seem to indicate. Any increase, again, in the length of the posterior cerebral arteries is *pro tanto* a disadvantage to the parts they feed. If the blood-current, as these facts seem to show, is slower in the posterior lobes of the brain, it is, upon purely physical principles of endosmosis and exosmosis, plain that these segments of the brain are less efficient organs for the mind to work with; and here again, "occipital dolichocephaly" would have a justification, though one founded on the facts of the nutrition of the brain-cells, not on the proportions of the braincase. In many (but not in all) parts of Continental Europe, again, the epithet "long-headed" would not have the laudatory connotation which, thanks to our Saxon blood, and in spite of the existence amongst us of other varieties of dolichocephaly, it still retains here. Now, the brachycephalic head (which, abroad‡ at least, is ordinarily a more capacious one, and carried on more vigorous shoulders and by more vigorous owners altogether, than the dolichocephalic, strikes a man who has been used to live amongst dolichocephali by nothing more forcibly, when he first comes to take notice of it, than by the nearness of its external ear to the back of the head; and this may be said to constitute an artistic occipital brachycephalism. But this does not imply that the converse condition is to be found conversely correlated, nor does

it justify the use of the phrase "occipital dolichocephaly" in any etymological, nor even in any ethnographical, sense.

I shall now content myself, as far as craniology is concerned, by an enumeration of some at least of the various recent memoirs upon the subject which appear to me to be of pre-eminent value. And foremost amongst these I will mention Professor Cleland's long and elaborate scientific and artistic paper on the Variations of the Human Skull, which appear in the "Philosophical Transactions" for 1869. Next I will name Ecker's admirable, though shorter, memoir on Cranial Curvature, which appeared in the "Archiv für Anthropologie," a journal already owing much to his labours, in the year 1871. Acby's writings I have already referred to, and Ihering's, to be found in recent numbers of the "Archiv für Anthropologie" and the "Zeitschrift für Ethnologie," deserve your notice. Professor Bischoff's paper on the Mutual Relations of the horizontal circumference of the Skull and of its contents to each other and to the weight of the Brain, has not, as I think, obtained the notice which it deserves. It is to be found in the "Proceedings" of the Royal Society of Munich for 1864, the same year which witnessed the publication of the now constantly quoted "Crania Helvetica," of Professors His and Rüttimeyer. Some of the most important results contained in this work, and much important matters besides, was made available to the exclusively English reader by Professor Huxley two years later, in the "Pre-historic Remains of Caithness." I have made a list, perhaps not an exhaustive one, but containing some dozen memoirs by Dr. Beddoe, and having read them or nearly all of them, I can with a very safe conscience recommend you all to do the like. I can say nearly the same as regards Broca and Virchow, adding that the former of these two *savans* has set the other two with whom I have coupled him an excellent example, by collecting and publishing his papers in consecutive volumes.

But I should forget not only what is due to the place in which I am speaking, but what is due to the subject I am here concerned with, if, in speaking of its literature, I omitted the name of your own townsman, Prichard. He has been called, and, I think, justly, the "father of modern anthropology." I am but putting the same thing in other words, and adding something more specific to it, when I compare his works to those of Gibbon and Thirlwall, and say that they have attained and seem likely to maintain permanently a position and importance commensurate with that of the "stately and undecaying" productions of those great English historians. Subsequently to the first appearance of those histories other works have appeared by other authors, who have dealt in them with the same periods of time. I have no wish to depreciate those works; their authors have not rarely rectified a slip and corrected an error into which their great predecessors had fallen. Nay, more, the later comers have by no means neglected to avail themselves of the advantages which the increase of knowledge and the vast political experience of the last thirty years have put at their disposal, and they have thus occasionally had opportunities of showing more of the true proportions and relations of even great events and catastrophes. Still the older works retain a lasting value, and will remain as solid testimonies to English intellect and English capacity for large undertakings as long as our now rapidly extending language and literature live. The same may be most truthfully said of Prichard's "Researches into the Physical History of Mankind." An increase of knowledge may supply us with fresh and with stronger arguments than he could command for some of the great conclusions for which he contended; such, notably, has been the case in the question (though question it can no longer be called) of the Unity of the human species; and by the employment of the philosophy of continuity and the doctrine of evolution, with which the world was not made acquainted till more than ten years after Prichard's death, many a weaker man than he has been enabled to bind into more readily manageable burdens the vast collections of facts with which he had to deal. Still his works remain, massive, impressive, enduring—much as the headlands along our southern coast stand out in the distance in their own grand outlines, whilst a close and minute inspection is necessary for the discernment of the forts and fosses added to them, indeed dug out of their substance in recent times. If we consider what the condition of the subject was when Prichard addressed himself to it, we shall be the better qualified to take and make an estimate of his merits. This Prichard has himself described to us, in a passage to be found in the preface to the third volume of the third edition of the "Physical History," published in the year 1841, and reminding one forcibly of a similar utterance of Aristotle's

\* Acby, "Schädelform des Menschen und der Affen," pp. 11, 12, and 128.

† Weisbach, "Die Schädelform der Roumanen," p. 32, 1869.

‡ See upon this point:—Broca, Bull. Soc. Anth. Paris, ii. p. 648, 1861; *ibid.* Dec. 5, 1872; Virchow, Archiv für Anth. v. p. 535; Zeitschrift für Ethnol. iv. 2, p. 36; Sammlungen, ix. 193, p. 45, 1874; Beddoe, Mem. Anth. Soc. Lond. ii. p. 350.



at the end of one of his logical treatises (Soph. Elench. cap. xxxiv. 6). These are his words:—

"No other writer has surveyed the same field, or any great part of it, from a similar point of view. . . . The lucubrations of Herder and other diffuse writers of the same description, while some of them possess a merit of their own, are not concerned in the same design, or directed towards the same scope. Their object is to portray national character as resulting from combined influences—physical, moral, and political. They abound in generalisations, often in the speculative flights of a discursive fancy, and afford little or no aid for the close induction from facts, which is the aim of the present work. Nor have these inquiries often come within the view of writers on geography, though the history of the globe is very incomplete without that of its human inhabitants." A generation has scarcely passed away since these words were published in 1841; we are living in 1875; yet what a change has been effected in the condition of anthropological literature! The existence of such a dignified quarterly as the "*Archiv für Anthropologie*," bearing on its title-page in alphabetical order the honoured names of V. Baer, of Desor, of Ecker, of Hellwald, of His, of Lindenschmidt, of Luce, of Rüttimeyer, of Schaafhausen, of Semper, of Virchow, of Vogt, and of Welcker, is in itself perhaps the most striking evidence of the advance made in this time, as being the most distinctly ponderable and in every sense the largest anthropological publication of the day.

Archæology, which but a short time back was studied in a way which admirably qualified its devotees for being called "connoisseurs," but which scarcely qualified them for being called men of science, has by its alliance with natural history and its adoption of natural history methods, and its availing itself of the light afforded by the great natural history principles just alluded to, entered on a new career. There is, as regards natural history, anatomy, and pathology, nothing left to be desired for the conjoint scheme represented by the periodical just mentioned, where we have V. Baer for the first and Virchow for the last, and the other names specified for the rest of these subjects; whilst archæology, the other party in the alliance, is very adequately represented by Lindenschmidt alone. But when I recollect that Prichard published a work "On the Eastern Origin of the Celtic Nations" ten years before the volume of "Researches," from which I have just quoted, and that this work has been spoken of as the work "which has made the greatest advance in Comparative Philology during the present century," I cannot but feel that the Redaction of the "*Archiv für Anthropologie*" have not as yet learnt all that may be learnt from the Bristol Ethnologist; and they would do well to add to the very strong staff represented on their title-page the name of some one, or the names of more than one comparative philologist. This the Berlin "*Zeitschrift*" has done.

Prof. Rolleston concluded by a few words on the possible curative application of some of the leading principles of modern Anthropology to some of the prevalent errors of the day.

#### MEETING OF THE ASTRONOMISCHE GESELLSCHAFT AT LEYDEN, AUGUST 13-16.

THE sixth biennial meeting of the Astronomische Gesellschaft, founded in the year 1863, at Heidelberg took place this year at Leyden, according to the international character of the Society, and in conformity with the resolution of the last meeting at Hamburg. The first session was opened by the President, O. Struve, in the rooms of the magnificent Observatory at Leyden. Besides him were present the following members: Auerbach, Bruhns, Engelmann, Scheibner, and Zöllner from Leipzig; Winnecke, and Hartwig from Strassburg; H. G. Bakhuyzen, E. F. Bakhuyzen, Kaiser, Schlegel and Valentiner, from Leyden; Gylden from Stockholm, Repsold from Hamburg, v. d. Willigen from Harlem, Förster and Tietjen from Berlin, Seeliger from Bonn, Bruns from Dorpat, Kortazzi from Nikolajew, Palisa from Pola, Bosscha from the Hague, Block from Odesa.

After an address from the Curator of the Leyden University, Baron Gevers van Endegreest, in which he spoke of the great merits of the late Director of the Leyden Observatory, the eminent Kaiser, and his exertions in promoting astronomical studies in Netherlands, the usual statistical notices were read.

The President stated that after the conclusion of the Hamburg meeting the number of members was 231, that 28 new

members had been admitted, while the loss by death or otherwise had been 24, so that the actual number of members was 235. He gave biographical notices of some of the deceased members, Hoek, Mödler, Argelander, Winlock, and d'Arrest. The treasurer, Auerbach, read the balance of the two last years' income and expenses; the secretary, Prof. Winnecke, reported that the publications of the Gesellschaft published were: Publication No. xiii.; Spörer, "Beobachtungen der Sonnenflecken zu Anklam mit 23 Tafeln," and "Vierteljahrsschrift der Astron. Gesellschaft," (vol. viii., 3, 4, vol. ix., vol. x., 1, 2, 3). Prof. Scheibner reported on the library and mentioned, amongst others, the very valuable gift of all the manuscripts of the great astronomer of Gotha, Hansen, made by his widow to the society.

Prof. Bruhns gave an account of the progress of work on comets, undertaken by the Society. Of especial interest was the communication and discussion on Encke's comet.

Prof. Scheibner presented the first copy of a posthumous memoir of Hansen on the Perturbations of Jupiter, and explained the present state of the undertaking.

Prof. Bruhns exhibited an apparatus for the graphical solution of Kepler's problem, and explained its use. The same communicated a description of a new photometer, the execution of which was in progress. Prof. Zöllner explained then, by a model, some improvements of his well-known photometer, through which it becomes more easily adapted to all kinds of telescopes. Some observations of Mars, made by Kononewitsch, appear to indicate a real diminution in the brightness of Mars.

Prof. Bakhuyzen laid before the Society two manuscript volumes, bought lately by the Leyden Observatory, "the *Areographischen Fragmente* by Schröter" long reputed to be lost. Besides these, he exhibited the very interesting diagrams of Mars made two centuries ago by the celebrated Huyghens.

Dr. Engelmann of Leipzig announced that he is preparing for press an edition of Bessel's various smaller papers.

At the second meeting, August 14, the members Astrand (Bergen), Gelmuyden (Christiania), Hohwü (Amsterdam), Neumayer (Berlin) were present, and six new members were admitted.

The Council gave the Report on the progress of the Meridional Zone work by which all stars down to the 9th inclination between 80° north and 2 south declination are catalogued. The following observatories partake in this great work: Kasan, Dorpat, Christiania, Helsingfors, Cambridge (U.S.), Bonn, Chicago, Leyden, Cambridge (England), Berlin, Leipzig, Neuenburg, Nikolajew.

It was then to be decided where the Gesellschaft would meet the next time. After an invitation by Prof. Gylden from Stockholm, the Gesellschaft decided on Stockholm for the seventh biennial meeting.

Prof. Förster of Berlin made a detailed communication on the situation of different Astronomical Institutions of Berlin, including those which are in the course of construction. The erection of the Astro-physical Observatory near Potsdam is in good progress. It has not yet been possible to appoint a Director for this extensive institution; meanwhile the services of Prof. Spörer, Dr. Vogel, and Dr. Lohse are secured for it. This new institution is intended to promote science principally in the higher optics, and their application to astronomy, while the Observatory at Berlin and the Institution for exact Numerical Computation under the direction of Prof. Tietjen will pursue their given ways.

Prof. Bakhuyzen exhibited a new wire micrometer, sent by Merz, and explained its peculiarities. Prof. Gylden gave a new solution of Kepler's problem with the aid of elliptical functions, and distributed some copies of a memoir on the use of elliptical integrals in the theory of the motion of the heavenly bodies. Dr. Palisa explained the construction of the new meridian circle at Pola by many large plates. Different papers sent to the meeting by Astrand, Covarrubias, Lockyer, and Struve were laid on the table.

The Observatory at Brussels appears, after the loss of its founder and genial director, Professor Quetelet, to be in a critical position. The Astronomische Gesellschaft resolved unanimously, that it is to be wished that the distinguished activity exhibited by the Brussels Observatory in the determination of the places of stars with sensible proper motion, may be maintained, and if possible, improved by completing its instrumental means. It is in the interest of science to reduce and print the results of the measures in question as soon as possible.